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INLAND FISHERIES AND GA

FOR THE

YEAR ENDING DECEMBER 31, 1901.

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Commonwealth of Massachusetts.

To His Excellency the Governor and Honorable Council.

The Commissioners on Inland Fisheries and Game respectfully submit their thirty-sixth annual report.

GENERAL CONSIDERATIONS.

Change in Designation of Commission. — The change in the designation of this commission, at the recent special session of the Legislature for the codification of laws of the Commonwealth, may be considered wise and important legislation. While the title, Commissioners on Inland Fisheries and Game, may have been formerly appropriate and satisfactory, it is evident that it is no longer properly applicable, when the duties and responsibilities of the commission have been largely enhanced, so that they cover the sea-coast fisheries, and when it should be in a position to present facts or suggestions which may prove beneficial to the commercial fisheries generally. That the commission has outgrown the designation it has heretofore held is patent, and that it has opportunity for further expansion under the title it will have after this year is also apparent. For, while it is true that all branches of the work relating to inland fisheries and game should be carried on with all possible vigor and effectiveness, it is also true that a State having such important sea fisheries as Massachusetts has should not be officially indifferent to their welfare. Public welfare demands that the commission do whatever it can, through inquiry or publication, to promote industries which in the past were stepping stones to the important commercial position now held by this Commonwealth, and still occupy a position of consequence in our industrial life.

In order, however, that this may be accomplished, new legislation will be required, authorizing the appointment, by the commission, of assistants, with suitable designations, for the purpose of making scientific or semi-scientific investigations, which a proper consideration of the fisheries may make necessary. At the present time there is no law which will admit of such an appointment, even when the services of scientific men or technical experts are tendered to the commission without charge by public-spirited citizens. It should be only necessary to invite attention to a condition so utterly at variance with the general attitude of the State towards its industries, to insure desired action by the Legislature.

Expansion of the Work. — The work of the commission has expanded materially in various directions. The facilities for hatching and rearing fish have been increased or perfected, as will be shown in detail elsewhere, and the output of young fish this year is about four times as great as in any year previous to 1900, notwithstanding many of those distributed this season were fingerlings and yearlings, whereas only fry were formerly produced.

The number of Mongolian pheasants liberated is about three and a half times as many as were generally sent out before. The Belgian hares put out to stock the covers in various sections of the State numbered more than two-thirds as many as the pheasants. Thus the aggregate of game birds and animals liberated was fully five times as many as have usually been put out.

Provision has been made to increase the future output of fish, birds and animals.

Valuable statistics of the shore fisheries have been gathered and tabulated. Never before has it been practicable for the commission to publish figures relating to fisheries which had real statistical value.

The commission has had the active co-operation of the Institute of Technology in the study of the difficult problems bearing on the lobster industry. It has been able to contribute to the scientific researches of various organizations, among which may be mentioned the Museum of Comparative Zoölogy at Cambridge.

Correspondence with various European countries and with Japan has been instituted for the purpose of securing information which may prove helpful to our fishery industries, and the chairman has lectured on necessary improvements of the fisheries.

Additions have been made to the collections illustrating work of the commission. A series of photographs of hatcheries and their surroundings, including ponds, pheas tries, etc., has been obtained. Fourteen of these have b used for bromide enlargements, and these have been suita framed. Contributions to the collection have been recei from some of the deputies. The head of a buck deer wh was illegally killed in this State has been mounted.

The advantage of having a collection, such as it is ho may sometime be acquired by the commission, can scarcely over-estimated. Its real practical value has already been de onstrated, even while it is yet very embryonic.

Appropriations. — The total amount appropriated for conduct of the commission's work in its various branches $21,002. It is not possible at this time to show the amo expended. It can only be said that the appropriation $1,000, made for fishways in accordance with chapter 3 Acts of 1900, has not been drawn upon and will consequen revert to the treasury of the Commonwealth.

Recommendation regarding Appropriation. — The comm sioners recommend that future appropriation bills shall cont a provision authorizing them to transfer ten per cent. of appropriation for a specific purpose — the enforcement of l for instance — to some other appropriation, providing the igencies of the work and the public welfare seem to demand If this can be done, or a special act embodying such a provis can be enacted, much advantage to the work will result, the real purpose of the Legislature in appropriating the agg gate sum will be better served.

Free Distribution of Fish, Birds and Animals. — The co mission is impressed with the idea that the free distribution fish, birds and animals it breeds or rears will be an import step forward in the effort to restock our inland waters and covers. This is done in other States, — certainly in nearly of them that make any pretence of carrying on such work u a scale commensurate with its importance. Not a few of States have cars of their own for distributing fish and fry, w the most approved equipment and trained crews. If it is wo while for the State to breed fish or game it is certainly important that the full result of its work in this direction shall be attained by making the commission responsible for distribution. This is in harmony with the most advanced thought and action of the foremost men and commonwealths in this country, not to speak of other countries.

Manifestly it is unwise to longer depend on fish being distributed by those not responsible to the commission, for while much may have been accomplished under the system heretofore prevailing, whereby fish are delivered to applicants at the hatcheries, it is scarcely to be expected that all will be experts in the care of fish, and considerable loss may result in consequence of inexperience, even when individuals are honestly desirous of carrying out the purposes of the commission. And whether or not there is foundation for disquieting assertions, as to the disposition of some of the fish, it certainly will be an advantage to know beyond question that fish intended for public waters, where alone they should be put, have not been used to stock private reserves, from which the public may be excluded.

It is imperative that birds and rabbits be liberated by the deputies of the commission, and this has been done, at some sacrifice of other interests. It is almost equally important that fish should also be distributed in like manner. The best results cannot otherwise be obtained.

Fish Culture.

Extent of Work, etc. — The work embraced under this head, which includes many things beside fish culture proper, has been carried on by the commission during the current year upon a more comprehensive scale than ever before. This applies not only to the magnitude of the work, and the results accomplished, but also to the fact that it has been broadened in the matter of species, propagated or reared on a large scale, and there has been much expansion of effort in other directions bearing strictly on the question of the preservation and increase of food fish in the Commonwealth.

The organization of this work as established last year has been continued. Commissioner Delano, the superintendent of hatcheries, has continuously given his active personal attention

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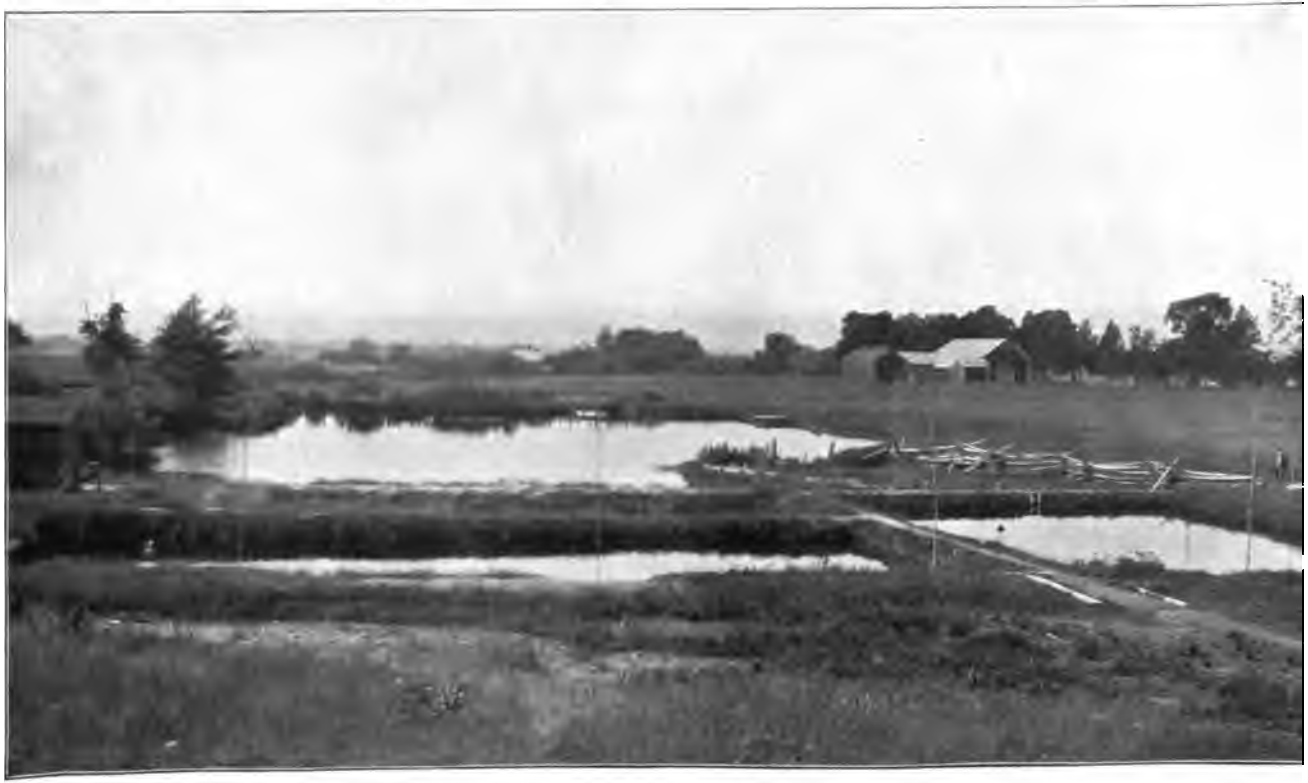

PONDS AT HADLEY FISH HATCHING STATION.—Artificial rearing ponds in foreground. One on left fed partly by springs.

to matters relating more strictly to fish culture proper, particularly in connection with the conduct and development of resources at the hatcheries, and in the distribution of fish, not only for stocking in the ordinary way, but under special acts which make it obligatory upon the commission to stock brooks and ponds and to regulate the fishing therein for a period not exceeding three years. In addition to this, he has co-operated with the chairman in the examination of dams and fishways, and, to a more limited extent, in the examination of ponds.

With one exception, of which detailed mention will be made in its proper place, the results secured have been satisfactory and far beyond anything heretofore attained in this State; so much so that, even with the obstacles encountered at Hadley, the output of fry, fingerlings and adult fish is much greater than ever before. In the mean time the future possibilities have been so largely advanced through the rearing of brood fish that we may confidently look forward to a much larger increase next year, and in subsequent years there is reasonable probability that the capacity of the State hatcheries will be taxed to their utmost. Present arrangements contemplate two broods of fish annually instead of one, and a consequent increase of the output of the hatcheries, which will be many times greater than heretofore. This has been made possible by the installation, at Sutton and Hadley, of hatching jars and glass aquaria for breeding the pike perch or hatching the eggs of other fresh-water species which can be incubated in jars. The fish cultural plans also contemplate at least three periods for stocking with fish instead of one. Trout fry will first be put out in the spring; these will be followed by pike perch fry, and possibly by yearling trout, and in the fall, fingerlings of various species of trout and landlocked salmon will be distributed. This plan was followed the present year with most satisfactory results, and there is no reason to doubt that it will prove equally efficient in the future, although it will doubtless be varied somewhat, especially by including other species, notably the white perch, for the fall distribution.

Appropriation.—Owing to the fact that the breeding and rearing of game birds and small game animals are carried on by the commission in connection with the hatcheries, the appropriation for fish culture was made applicable to these also. The

to matters relating more strictly to fish culture proper, particularly in connection with the conduct and development of resources at the hatcheries, and in the distribution of fish, not only for stocking in the ordinary way, but under special acts which make it obligatory upon the commission to stock brooks and ponds and to regulate the fishing therein for a period not exceeding three years. In addition to this, he has co-operated with the chairman in the examination of dams and fishways, and, to a more limited extent, in the examination of ponds.

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Appropriation. — Owing to the fact that the breeding and rearing of game birds and small game animals are carried on by sum of $4,877 was appropriated "for the propagation and distribution of fish, birds and other animals, running expenses, and the rent and maintenance of hatcheries." While this has sufficed, the expense attendant upon the distribution of birds and animals was much larger than anticipated, owing to the increase in output and consequently the closest economy in other directions was necessary.

In addition to the above-named amount $500 was appropriated for stocking ponds, under chapter 208, Acts of 1897, and a similar sum for stocking brooks, in accordance with chapter 284, Acts of 1900. This makes a total of $5,877 for fish cultural purposes chiefly, but something less than this will be used, though the exact amount can be determined only after the close of the year, or after the publication of this report.

Output of Fish. — About the usual quantity of trout fry, 865,000, was distributed in the spring. In addition to these, 2,600,000 pike perch fry, hatched at the Sutton and Hadley stations from eggs received from the United States Fish Commission, were put into ponds shortly after the brooks were stocked with trout fry. Besides these, 11,500 yearling and 44,750 fingerling brook trout have been put into the brooks, and 15,000 rainbow trout fingerlings, 13,000 landlocked salmon fingerlings, 586 yearling Loch Leven trout and 250 four-year-old brook trout have been distributed in various ponds. This makes a total of 3,550,086 fish distributed by the commission this year for stocking the inland waters of the State. It is noteworthy, too, that more than 80,000 of the fish above enumerated were fingerlings and yearlings, concededly more valuable for stocking purposes than ten times as many fry. Mention may also be made of the reservation of several thousands of fingerlings and yearlings for increasing the stock of brood fish at the two principal hatcheries.

Enemies to Trout. — The work of rearing trout and keeping a supply of brood fish is made more or less difficult by the presence of various enemies to these fish at the hatching stations. Among these are minks, fish hawks, kingfishers, eels and water snakes. To what extent minks have preyed on trout in the hatchery ponds is a matter of conjecture. Superintendent Tri [illegible]ught one or more at the Hadley station, and their presence may account for some decimation of trout that has been noticed, although this may be due to eels.

On one occasion during the summer, while Mr. Tripp was engaged in the attempt to sink a well some little distance from the hatchery at Hadley, and on the opposite side of the building from the pond wherein the brood trout are kept, he chanced to turn in the direction of the pond and saw a large fish hawk just rising from the water with a trout in its claws. How often this had been done can only be conjectured.

In one of the small rearing pools, where Mr. Tripp had been endeavoring to raise some trout fingerlings, he noticed that the young fish grew less and less from day to day, but as there were no dead fish on the bottom of the pool he was at a loss to account for the gradual diminution. On two occasions he drew the water nearly out of the pool in the endeavor to discover the cause, but he could find no trace of anything which would give him a clue. But as the trout continued to disappear, he finally drew the pool down for the third time, and covered the bottom of it with fine, white sand, thinking that might possibly aid him in securing information which he had previously failed to obtain. He was correct in this conclusion, for the sand led to the discovery of two eels, which were dragged from the mud in the bottom of the pool. One was sixteen inches long and the other two feet or more in length. The discovery of these solved the problem of the disappearance of trout.

Fish hawks have not been known to make predatory attacks on trout at the Sutton hatchery this year, but formerly they were occasionally troublesome there. But the trout are not exempt from attacks of kingfishers. One day early in October, when the chairman and superintendent of hatcheries were visiting the hatchery, a kingfisher was caught in a trap that is always kept set in summer for these birds.

On the same day, a Mr. Wilson of Worcester, who was out to the hatchery for the purpose of securing some frogs for scientific purposes, succeeded in killing a water snake about forty-two inches long and approximately five inches in circumference. This snake was killed in immediate proximity to the rearing ponds, near the hatchery, where the young trout are being raised for breeders. When opened, the snake was found to have four trout in its stomach, each ranging from five to seven inches in length. Two of them were Loch Leven trout, one six and one-half inches and one seven inches long, and the other two were brook trout.

Mr. Merrill says that "formerly many of these snakes were killed about the upper ponds, but this year they have been less plentiful there, and not one has been killed. Their absence may account in part for the increased number of fingerlings in those ponds."

Work at the Hatcheries. — In various directions an effort has been made to enlarge and perfect the facilities for conducting fish-cultural and other work at the stations on an expanding scale. Mention is made elsewhere of the result of breeding birds and rabbits at Winchester and Sutton, and further allusion to that may be omitted here. Important improvements have been made at the Sutton hatchery by repairing the wooden pens, which were in bad condition; making changes in the supply pipe that carries water into the hatchery; building a dam and screen in the main brook below the hatchery, so that young fish can be kept there for renewing the brood stock in the large pond whenever necessary; repainting all the buildings and otherwise improving them. The hatchery has been equipped with a dozen Chase jars and necessary piping, glass aquaria, etc., for their successful operation.

An effort has been made to secure one or more flowing wells at Hadley, situated so as to supply the hatchery with an unfailing supply of spring water of nearly uniform temperature, suitable for breeding and rearing trout. All attempts have failed, however, despite the labor expended, and the question of a supply of spring water still remains the most important problem connected with the hatchery. It is of so much consequence that an appropriation will be asked for to enable the commission to drive an artesian well, without which there seems little prospect of making this station suitable for rearing fish, and it may not always be relied on with certainty for hatching them, since it is conceivable that the water supply may sometimes fail, even in winter, though of course this is improbable.

The hatchery has been equipped with glass hatching jars, etc., similar in number and type to those at Sutton, and, except for its lack of a supply of suitable water, is in first-class condition for breeding large numbers of fish. It is intended to double the jar-hatching capacity at both stations next year, this being absolutely necessary.

Rearing Young Fish. — The effort to rear trout and land-locked salmon to fingerlings or larger, which was inaugurated last year, was continued on a larger scale this year. The success attained at Sutton was notable and gratifying. At Hadley, however, the result was disastrous and disappointing. This was due almost wholly to the lack of spring water of nearly uniform temperature. It was hoped and expected that the brook water, which runs through the land controlled by the commission, would prove suitable for rearing brook trout to fingerlings, especially as its temperature is generally not high, and the fluctuations were not deemed extreme for surface water. A long penstock brought a supply of the brook water, and fed it into a system of rearing tubs placed on each side, so that each tub received a stream direct, the water in no case passing from one tub to another. The volume of water was ample; it was also swift and seemed to be well aërated. Every precaution was taken to insure its purity. But as the season advanced and the weather grew warm the brook trout, which at first appeared to be doing well, were attacked with a form of gill disease, and it soon became evident that the water was infested with a very destructive parasite. All the ordinary and well-known remedies were tried, but nothing availed to permanently check the trouble, the result being that only a few of the young brook trout survived.

The rainbow trout did better, probably because they are less easily affected by fluctuation of temperature, or a moderate rise of it, and also because they are evidently not so susceptible as brook trout are to attacks of this particular parasite. Still, they suffered and did not thrive as well as at Sutton. Some rainbow trout in their second year, confined in pens where the temperature was considerably higher than in the tubs, seemed to do well, and a lot of two-year-old brown trout in one of the pools above the main pond, which is fed partly by the brook and partly by springs, were healthy and grew finely. They were not troubled by the gill parasite that killed the young brook trout in such large numbers.

The year's work at Hadley has demonstrated the feasibility of successfully rearing brood fish from trout, which may be taken there of the size of yearlings, or thereabouts; but the rearing of fingerlings from brook trout fry, which is still more important, cannot apparently be accomplished without excessive loss, unless it is practicable to secure a supply of spring water. Much better results may be anticipated in rearing rainbow trout, especially if the ravages of the gill parasite can be minimized. Efforts will be made the coming year to determine definitely what can be done in this direction.

Certain improvements at Sutton are much needed. The floor of the hatchery is in bad condition and repairs should be made next year. Cattle from adjoining pastures have done more or less damage to the property of the commission at this station, and it is considered imperatively necessary to build a wire fence around the State land.

At Winchester the pipe which supplies the hatchery with water is worn out, and should be replaced by a new one.

Rearing Ponds, etc. — At Hadley, a new rearing pond, fifty feet by seventy-five feet, has been built during the present year above the main pond. This is fed in part by the brook, which also supplies the tub system, the main pond or other pools; but the supply of water has been largely increased in volume and fitness by driving pipes some distance into the alluvial bottom of the artificial pool. Something additional has been done to perfect the rearing pond system at the station, and the superintendent has worked zealously to improve conditions, doing a large part of the manual labor himself. His efforts to find a flowing well for the hatching house has, however, demanded even a larger amount of labor, and unfortunately this has been so far unproductive.

The single well which has heretofore supplied the limited amount of water used in the hatchery was believed to be an unfailing spring, and when the site was selected there was full reliance on a continuous supply of water, sufficient in volume for hatching purposes, beyond which nothing was then contemplated. But the long-continued hot, dry periods of the past two summers developed the fact that the well [illegible] never sufficient to furnish the volume of water required for h pacity of the hatchery, — is not an unfailing spring, but is only what may be termed a surface well, therefore subject to fluctuation and liable to go nearly dry.

As already indicated, several attempts have been made during the year to increase the supply of water by digging or driving wells on ground sufficiently high to permit the water to flow to the hatchery by gravitation; but in every instance a strata of hard-pan has been struck about ten feet below the surface. This can, of course, be penetrated only by drilling, but there is apparently no other way of tapping a spring. That there may be some uncertainty as to the result is recognized, but the contour of the adjacent hills inspires confidence in the attempt to secure an unfailing supply of spring water, of practically unvarying temperature, by sinking an artesian well to a considerable depth. If such an attempt should prove successful, the water thus obtained would not only supply the hatchery, but could also be utilized for rearing trout fry to fingerlings. Everything depends on it, and until this question is settled it is considered inadvisable to make any further attempt to develop the station along the lines marked out.

The stock of brood fish at Hadley are in a healthy condition; it is believed few have died during the year. It may, however, be said that the result might have been different except for the flowing wells in one of the upper rearing ponds, to which allusion has already been made. Without these it is very doubtful if the adult fish in the large pond could have been saved, for the overflow of the artificial pool added considerably to the water supply in the main pond, and also improved the temperature materially.

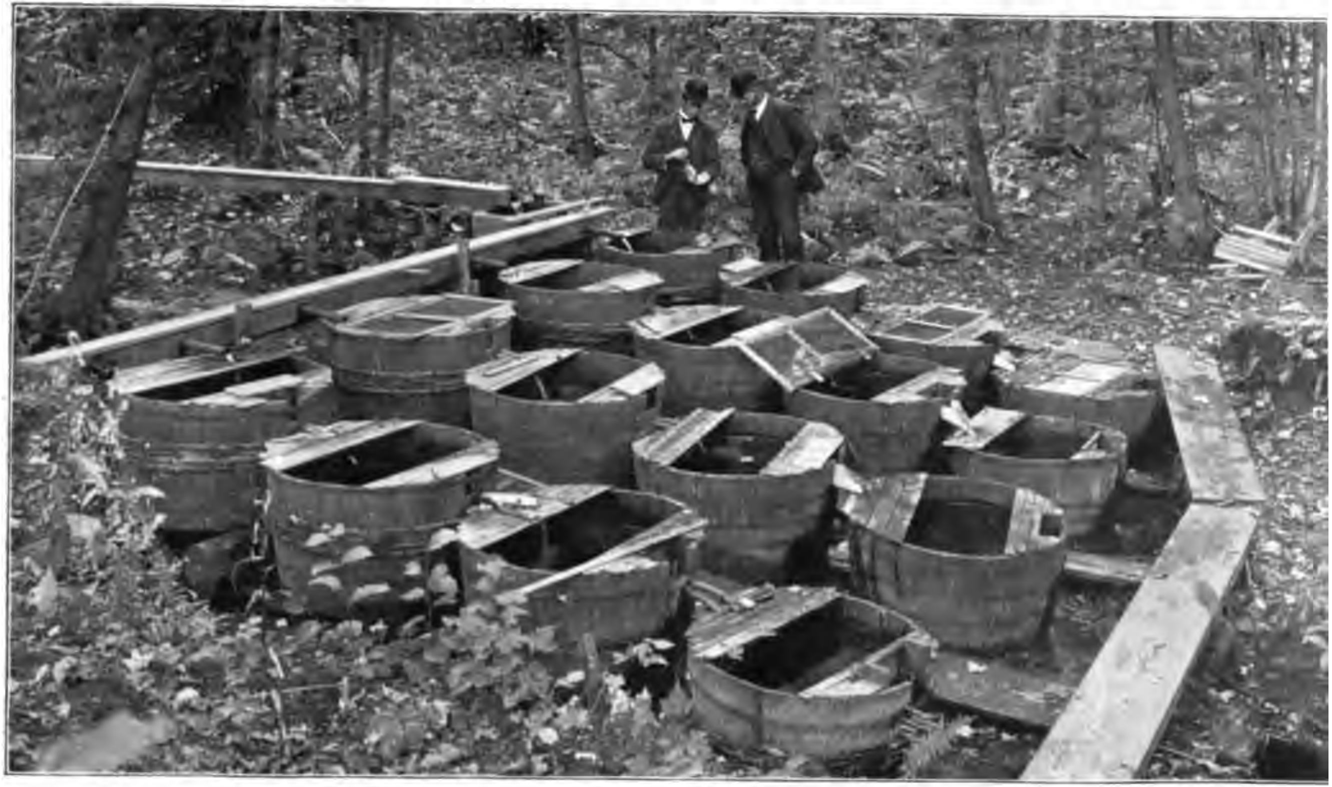
The rearing pond system at Sutton has been improved to the extent of enlarging one of the upper pools. This was substantially all that could be done, for about all the available space on the State land suitable for rearing ponds has been utilized. Additional advancement along this line at that station is contingent upon the purchase of a few acres of adjacent swamp land, of nominal value. This, although of small extent, belongs to two estates, and the determination of exact boundaries is necessary before conveyance can be made. Meanwhile, the owners have very courteously permitted the partial occupancy of it by the commission, free of charge,—an act on th part which has materially aided in the satisfactory conduct the work at this station.

The tub system, for raising trout fry to fingerlings, h worked admirably at Sutton, where the water is uniform pure and of a low temperature. A portion of the tubs, sixte in number, were installed in a group on the land referred just beyond the boundaries of the State land. They sat in slight depression, and were so placed that the water broug through a penstock to each one of the four higher tubs, passe by overflow into the three tubs below, one after the othe Thus a small stream sufficed for four tubs, and no doubt exist that the same volume of water might continue on to sever other tubs with equally satisfactory results.

The experience of two years at Sutton has demonstrate beyond question that, where a fair supply of cool spring wate is obtainable, the tub system is superior to any other for rearing fry to fingerlings. It gives the best results because the fish are protected from enemies at a time when they are most in need of protection; for the reason that dead fish, stale food, etc., can be easily removed, thus insuring the purity of the water; and ample shade, so much needed by trout, can always be provided by the covers, which, being partially of wire netting, readily admit all requisite air and light. By no other system we are familiar with can a limited supply of water produce such large results. In addition, it is unquestionably the cheapest artificial arrangement for rearing trout now available.

Brood Fish.—There are now available about 6,000 brood trout, ranging from eighteen months upwards in age. These are in fine condition. They consist of brook trout, brown trout and rainbow trout chiefly, though there are only a few of the latter old enough to spawn. There are also a few Loch Leven trout.

Measures have been taken to maintain and increase the brood stock of fish by keeping in reserve sufficient young trout to meet all anticipated needs. It will require a little time to attain the maximum aimed at, especially so far as the rainbow trout is concerned, since this is much older than the brook trout when it begins to yield eggs. But the rapid growth of



THE "TUB SYSTEM" AT THE SUTTON HATCHERY.—Examining young trout.

the few rainbows at Sutton, and the fact that the species is prolific, yielding 2,500 to 3,000 eggs at six years of age, are reasons for anticipating success when the young fish we now have reach the breeding age of three years.

Another year the yield of eggs from brook trout and brown trout should be large, but it will be about two years or more before the rainbow trout will attain sexual maturity.

Mention should not be omitted of the fact that a very few landlocked salmon have been retained at Sutton. These were two years old last spring, and the experiment of attempting to raise them to a breeding age is an interesting one.

Taking Trout Eggs. — The work of taking and impregnating trout eggs at the stations in Sutton and Hadley began about November 1, as usual, and 1,021,000 eggs have been obtained. This is considerably in excess of the number secured at the same date last year, and justifies the expectation that the total yield will be a record in this branch of the commission's work.

Introduction of New Species. — The commission has made a notable advance during the year in the work embraced under this head, and at no time in its history have the results attained in this direction even approximated those of which mention will be made. The fact, too, that what has been already accomplished makes probable still greater results in the future, adds to the importance of the work done, and suggests possibilities in the restocking of our inland waters not heretofore deemed attainable.

In point of numbers, the stocking of our ponds with 2,600,000 fry of the pike perch (*Stizostedion vitreum*) is the most important event of the year, in the introduction of new species. This species was described at some length in our last report. The fact that information has indirectly reached the commission that young pike perch were taken last spring or summer in Mystic Pond, where they had been planted as fry the previous year, suggests the probability of the species thriving in some of our ponds at least. While no member of the commission saw the fish caught in Mystic Pond, the statement seemed to be well authenticated that boys fishing there took some fish which "looked like pickerel but were not pickerel." This would perch, for no other fish in Massachusetts waters would answer to that description.

If, then, the pike perch can be successfully introduced, it is evident that much greater results may reasonably be anticipated from plants of 200,000 or 500,000 fish in a pond, than by putting into it from 200 to 400 white perch, even if the latter are half grown. And it may be said here that the pike perch is a true perch,—the largest of the perch family,—and that in food and game qualities it is conceded to equal or surpass any of the smaller varieties.

There are, however, some of our ponds in which the conditions are not suitable for the pike perch, and others which it is desirable to stock with several other species of fish. For this reason it has been deemed desirable to attempt stocking some of the ponds with fingerlings of the rainbow trout (*Salmo irideus*), a species which is believed to be peculiarly fitted to the conditions which obtain in a majority of the ponds in this State. There is, indeed, reason for anticipating greater success with this than with any other trout in the attempt to stock our ponds with a species which is alike desirable for food and game purposes. As is well known, the rainbow trout, though indigenous to the Pacific coast waters, has been successfully introduced in many of the eastern and central States. It thrives under conditions where our native brook trout could not exist, especially so far as temperature is concerned, and for that reason may also be used for stocking brooks which, because of defoliation, have become so warm that brook trout can no longer live in them. It may not be generally known that a condition like this prevails in Massachusetts, but such is a fact, as will be shown by the following extract from a letter received from Deputy George E. Whitehead of Millbury:

> I would say that the brook where I propose to try the rainbow trout is ruined so far as *Fontinalis* is concerned. I know of 35,000 fry that have been placed there inside of seven years. There are only a few very small brook trout in the extreme upper part of the brook. The lumberman with his steam saw-mill on wheels is responsible. Where there used to be two miles of heavy growth timber, it is now bare of everything but scrubs. There are three miles of meadows and mowing land below where it was once good trout fishing. The water is now so warm that our brook trout will not live there except

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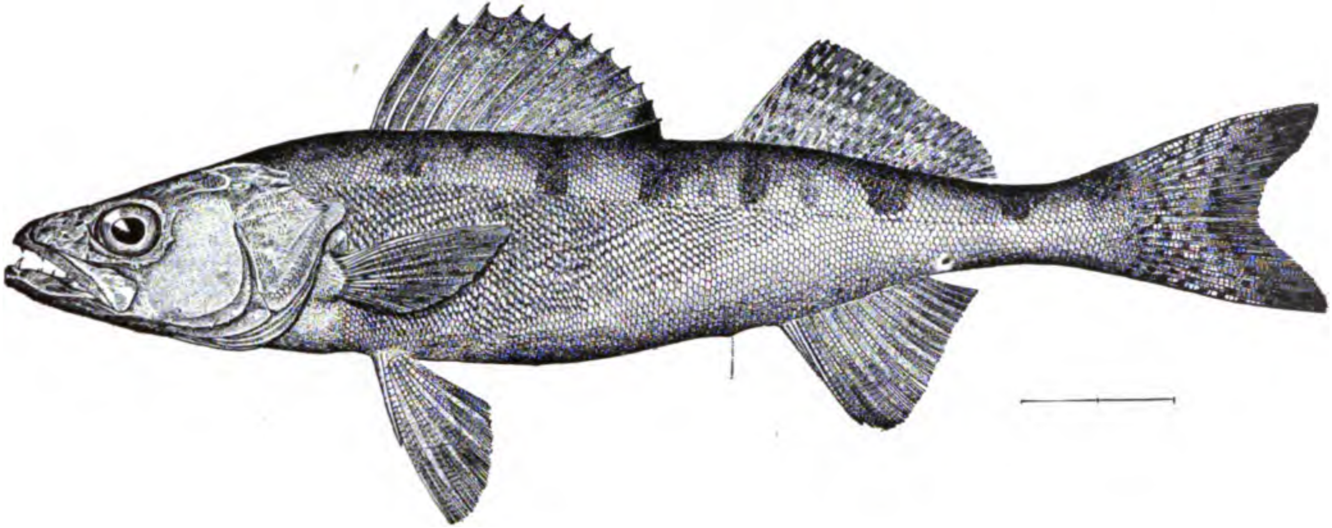

STIZOSTEDION VITREUM. — Pike Perch or Wall-eyed Pike.

very early in the spring. Now it looks to me as if the rainbow trout should find congenial quarters. The brook is mostly hard gravel bottom with just enough rapids to re-aërate the water. It has been my impression that the rainbows would inhabit the lower reaches of this brook and not interfere in any way with the few brook trout that are in the upper and colder waters. The long stretch of water that is now unproductive would then be made to produce a fish that is but little inferior to the brook trout.

Many of our ponds have a temperature too high for any of the salmonidæ to thrive in except it be the rainbow trout, and as these ponds abound with worms and insect larvæ, which constitute the favorite food of this species, there is good reason for thinking it will do well, since, as already stated, it is not unfavorably affected by moderately warm water. It has, however, been the aim of the commission to put this trout in ponds having a considerable variation of temperature in mid-summer, at different depths, and thus to give it an opportunity to select the conditions most agreeable to it.

Under favorable environments the rainbow trout grows rapidly, and attains a maximum of 12 or 13 pounds, but it is generally much smaller if the water is cold. Fish of this species in the pond at the State fish hatchery in Sutton weighed 3¼ pounds when two and a half years old. It is reputed to be a fine food fish, also a good biter and a sturdy fighter, though it must be considered secondary in food and game qualities to our native brook trout, which is almost without a peer in these regards. Its special recommendation is that it seems well adapted to many of our ponds. If this assumption proves true, and it is practicable to have our ponds fairly well stocked with a fish that grows to the size of a salmon under favorable conditions; that is graceful in outline, beautiful in color, and possesses other desirable qualifications, it is evident a material advance in the State's fish-cultural work will have been accomplished. With this end in view steps have been taken to secure a supply of brood fish of this species at our hatching stations in Sutton and Hadley, and an effort will be made to rear to the fingerling size the rainbow trout bred at our hatcheries.

The commission is likewise preparing to extensively breed the European brown trout (*S. fario*) and it now has a lot of a considerable yield of eggs will be obtained at the close of the present year.

The brown trout was introduced in the United States in 1883, and since then has been widely distributed, so that now it is well established in many States where the conditions are suitable for it. It is essentially a brook trout, requires cool water, but is reputed to thrive at the mouths of streams tributary to ponds or lakes. The experiment will be made of putting it into some of our ponds having a low temperature, and with streams running into them. It is also possible it may thrive in some of our brooks where the conditions are no longer suitable for native brook trout.

This species has been credited with attaining a weight of 22 pounds under favorable conditions. Among the brown trout in the aquarial exhibit of Wisconsin at the World's Columbian Exposition were numerous specimens which must have weighed from 9 to 11 pounds, although a weight of 5 or 6 pounds may be considered a good average. It is a matter of record that "in the United States, a wild specimen, seven years old, weighed about 11 pounds."*

The food and game qualities of this species are scarcely secondary to those of our native brook trout. Its adaptability to capture with artificial flies and its gameness are well known.

The Loch Leven trout (*S. levenensis*) is also receiving some attention from the commission, chiefly with a view to its utilization in stocking ponds. As its name indicates, it is essentially a pond trout, but it is a closely related species to the brown trout. It has the characteristics of the latter, the chief difference being that it has become specially adapted to ponds.

An attempt was made to secure some calico bass (*Pomoxis sparoides*) in the spring for stocking purposes, but it was not found practicable to obtain them, owing to the fact that the parties who could have supplied them last year were not in a position to furnish them last spring.

Stocking Ponds. — Twenty great ponds of the State have been stocked and the fisheries therein regulated, under chapter 208, Acts of 1897. This is a record in this particular line of the commission's fish-cultural work, the ponds thus stocked under the act referred to being more than were ever stocked

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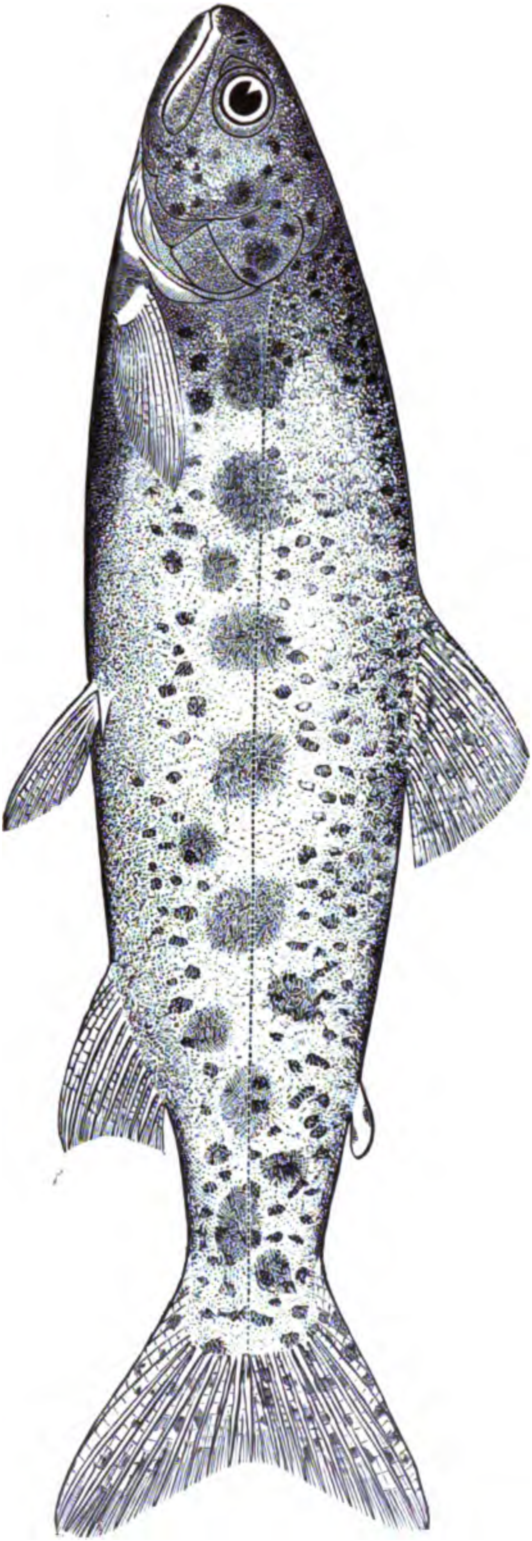
* [illegible] Fish Commission, [illegible]



RAINBOW TROUT.—*Salmo irideus.*

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in any previous year. Beside this, several other ponds were stocked by request, and some that had been stocked and closed the previous year were restocked, as will appear in the detailed statement.

The ponds stocked under the act mentioned were as follows: Assawompsett Pond, Lakeville; Great Pond, North Andover; Long Pond and Round Pond, Tewksbury; Pleasant Pond, Wenham; Round Pond and Forest Lake, Palmer; Packard Pond, Orange; Horn Pond, Woburn; Quincy Reservoir, Braintree;* Watuppa Lake, Fall River; Solomon's Pond, Northborough; Chadwick's Pond, Haverhill; Fowler's Pond, Boxford; Fort Pond, Littleton; Foster's Pond, Andover; Middle Pond, North Dana; Island Pond, Plymouth; Lily Pond, Cohasset; Monponsett Pond, Halifax; and Lake Chaubunagungamaug, Webster.†

With the exception of Quincy Reservoir, which, by special request, was closed to fishing for three years, Chadwick's Pond, Haverhill, and Fowler's Pond, Boxford, which were closed to Sunday fishing, uniform regulations were applied to all the above-mentioned ponds and lakes. These regulations prohibit for three years from date of issuance "all fishing from the first day of November to the first day of June of each year for a term of three years." Fishing is permitted, however, "with single hook and hand line on Monday, Wednesday and Saturday of each week, from the first day of June to the first day of November of each year," while the regulations are in force. A penalty of twenty dollars for violation of the regulations is fixed by the commission.

The following ponds, which were stocked with white perch in 1900, and the fishing therein regulated under chapter 208, Acts of 1897, were also stocked with pike perch fry in 1901, an allotment of 200,000 fry being put into each: White or Southwest Pond, Athol; Lower Bridgman Pond, Belchertown; Quabbin Lake, Greenwich.

Upper Bridgman Pond, Belchertown, and Wequaguet Lake,

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* Each of the ten ponds first mentioned, with the exception of Round Pond, Tewksbury, and Forest Lake, Palmer, was stocked with 200,000 pike perch fry. In addition, Quincy Reservoir was stocked with rainbow trout fingerlings.

† Fourteen of the ponds enumerated were stocked with rainbow trout fingerlings. One of these was also stocked with pike perch, and several others were stocked with landlocked salmon fingerlings in addition to the rainbow trout.

Barnstable, both of which were stocked and regulated in 1900, were stocked with rainbow trout fingerlings in 1901.

Lake Quinsigamond, Worcester, in which fishing is regulated for five years by a special law (chapter 158, Acts of 1901), has been stocked with brook trout and landlocked salmon.

In addition to all these, Cape Pond, Gloucester, and Forge Pond, Granby, have each been stocked with 200,000 pike perch fry, by request, but no restrictions have been applied to them.

Restocking Ponds. — Although the decision of the Attorney-General was published in our last report, and this clearly and fully sets forth the fact that the commission, having once stocked a pond and regulated the fishing therein in accordance with chapter 208, Acts of 1897, has no authority thereafter to renew such regulations, appeals have been received this year urging that certain ponds be restocked and the fishing regulations relating thereto be renewed. Inquiries as to the commission's authority to take further action, after the expiration of the period during which fishing has been regulated in a pond, have been received, and these invariably evince much concern as to the result of unlimited fishing in a pond wherein the supply of fish has been improved by limiting fishing. All this indicates a strong popular desire for a law which will in some way limit fishing in ponds. It is recognized by all who have studied the question that nothing less than almost utter depletion can be expected in ponds where ice fishing is permitted. When one individual can use a multiplicity of lines and hooks for the capture of pond fish, whether it be in winter or summer, it is not difficult to predict the result. It is quite impossible with any means now at command to keep up the supply of fish in such small areas of water, if unrestricted fishing is permitted; consequently, waters which might annually yield large quantities of fish, if the supply is reasonably conserved, become more or less barren, especially so far as the most desirable species of fish are concerned.

It is the present policy of the commission to add to the resources of closed ponds by stocking them each year, if possible, while they are closed, but this can effect no permanent good, if no limit can subsequently be put on fishing, for if such efforts result in filling ponds with fish, and that fact is known, as it is sure to be, the rush to catch as many as possible at the termination of the closed period will soon result in depletion, and thus the best intentions of the State will be defeated.

The effect of the prohibition of unrestricted fishing through the ice is well demonstrated in the following extract from a report made on June 26, 1901, by Deputy Otis Foster of Pembroke, who says: "There has been as many fish taken out of the three ponds this month as there was the whole season last year. That shows that not fishing through the ice has made the difference."

Stocking and Closing Brooks. — Two brooks have been stocked with yearling brook trout, and the fishing therein has been regulated, under chapter 284, Acts of 1900. These are as follows: Argelia, or Brown's Brook, in the town of Groveland, and Flat Brook in the town of Ware.

The first of these brooks is closed to "all fishing for three years from June 5, 1901, with the following exception;" fishing is permitted "with single hook and hand line on Tuesday, Thursday and Saturday of each week, between the first day of April and the first day of September in the year ending June 5, 1904."

Flat Brook is closed "to all fishing for three years from June 12, 1901."

Examination of Ponds. — The importance of obtaining a few leading facts concerning the great ponds of the State will be apparent to all. Without such data it is impracticable to act intelligently in regard to stocking our inland waters. As is well known, fish, being cold-blooded animals, are dependent for comfort and even existence upon the temperature of the water in which they are placed. Certain species require a low and nearly uniform temperature, and it would be a manifest error to put such into a pond having only comparatively warm water, in which it would be impossible for the fish to thrive or even to live. It is, therefore, evident that the best-intentioned efforts may be defeated, and public money may be expended to no purpose, if there is not in the possession of the commission knowledge of conditions which will make possible approximately correct conclusions regarding the proper action to take in stocking a pond. It is one thing to stock a pond without any basis for estimating the result, which is for lack of knowledge fully as liable to prove a failure as anything else; and it is quite another matter to stock it with full information of its leading characteristics, and thus have reasonable assurance of success. It is unquestionably important to do whatever seems feasible to insure the increase of fish in our inland waters, and nothing, perhaps, can more surely lead to this than a knowledge of the conditions in our ponds and lakes which may influence the stocking of them.

With this end in view, every opportunity has been improved by the chairman to continue the examination of ponds, and thus to supplement the work in this direction which was begun last year.

Nineteen ponds were examined as to temperature, depths, bottom, etc., and seven other ponds were visited; but it was not practicable to make a complete examination of the latter, because boats were not available. In a majority of these cases, however, sufficient knowledge was obtained to serve the purpose of the commission, so far as stocking the ponds is concerned; for most if not all of those visited and not fully examined are shallow, with water of relatively high temperature. Following are brief statements of the most notable conditions in the ponds visited or examined: —

Triangle Pond, Sandwich: The most noticeable species of fish in this pond are white and yellow perch, black bass and pickerel. There are also some sunfish or roach, and minnows, locally called "transparent" minnows. The bottom is composed chiefly of sand, gravel and pebbles, but has muddy areas, generally of small extent. The greatest depth found was 31 feet. The temperatures on June 14 were as follows: surface, 70° F.; at a depth of 23 feet, 68°; and at a depth of 27 and 31 feet, 66°.

Great Herring Pond, Plymouth: This pond is noted for an abundance of yellow and white perch and alewives. It also has pickerel, black bass, suckers, hornpouts or catfish, eels, roach or sunfish and shiners. On June 17 alewives were seen in large numbers around or near the shores of the pond, apparently in the act of spawning. The bottom of this pond is more or less varied, being composed of sand, gravel, pebbles and mud, with patches of moss or grass, particularly in shallow sections. On June 17 the surface temperature was

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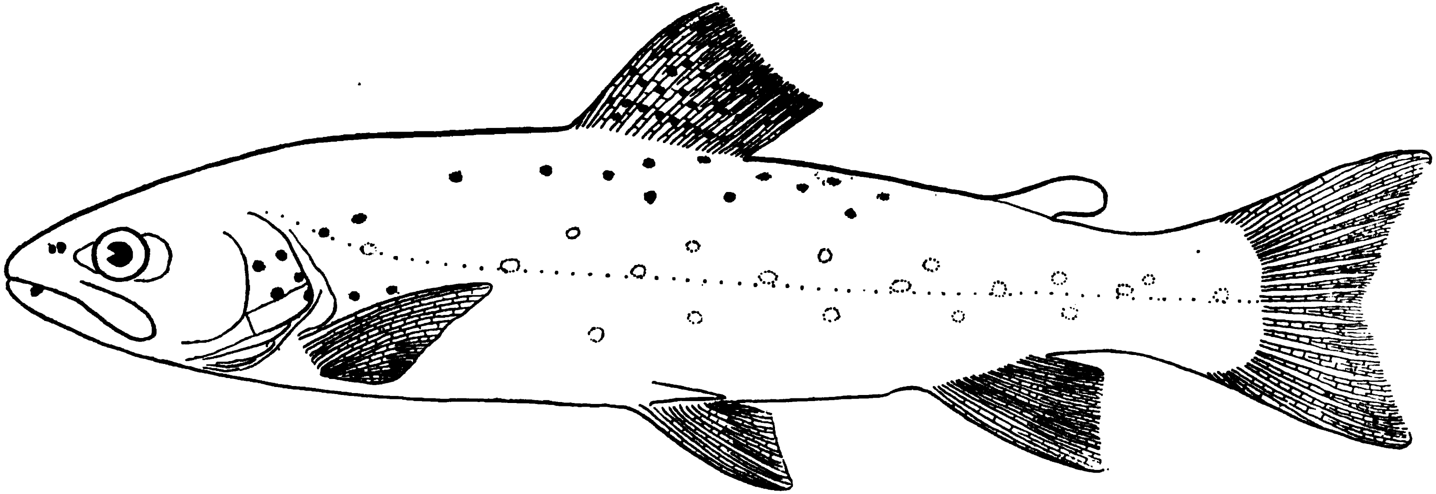

BROWN TROUT.—*Salmo fario.*

68° F., and was 65° F. at depths ranging from 28 to 35 feet. Alewives were reported to be exceptionally abundant during the present year, and it was stated by local residents that fully three thousand barrels of this species had been taken by fishermen during the migratory period. The season was notable from the fact that there appeared to be an unusual number of dead alewives in the pond, so much so that the authorities had to take measures to remove the fish from the shores, where they caused more or less stench. As many as fifteen barrels were removed on one occasion a few days before the pond was visited.

Island Pond, near Herring Pond, Plymouth: Inasmuch as it was not practicable last year to examine this pond in a satisfactory manner, a second visit was made to it on June 18 of the present year. The principal species of fish which occur in this pond are small-mouth black bass, pickerel, yellow perch, and hornpout or catfish. The latter are reputed to be abundant. It also has some shiners. The bottom is more or less diversified, and consists principally of patches of sand, gravel, pebbles and stones. It has a growth of grass pretty generally distributed over the pond, and for this reason the fishermen call it a "mossy bottom." There are a few lily pads in the shallower parts of the pond, but generally these are not abundant. The surface temperature on June 18 was 71° F., 69° in from 22 to 24 feet. As a rule, the bottom declines quickly from the shore to a depth of 12 to 16 feet, except in the coves, where it falls off more gradually.

Elbow Pond, Plymouth: The principal species of fish in this pond are black bass, yellow perch, pickerel, and catfish or hornpout. The bottom is composed chiefly of sand, gravel, pebbles and stones, but is for the most part covered with grass, and is therefore considered "mossy bottom." In some places the bottom slopes off very gradually from the shore, in others it falls off quickly into comparatively deep water. This pond is shallow and has much less water than Island Pond, the extreme depth obtained being only 16 feet. The surface temperature was 71° F., and the temperature at a depth of 15 feet was 69°.

Big Sandy Pond, Plymouth: This pond has apparently a greater abundance of fish than other waters in the immediate vicinity, due somewhat to its having been rather heavily stocked both by the United States Fish Commission and the State Commission. The principal species are black bass, pickerel, white and yellow perch, catfish or hornpout, dace, and sunfish or roach. Capt. Z. B. Godfrey, who has a camp here, is authority for the statement that in 1885 and 1886 the pond was stocked with landlocked salmon, and that it was also stocked with eight thousand lake trout fry in 1895. So far as he knows, however, neither of these species have been taken. The pond was also stocked with black bass in 1895 and again in 1899, according to Captain Godfrey. The bottom is composed chiefly of sand, gravel, pebbles and small stones, but has patches of soft mud. Throughout a large part of its extent it has a growth of grass. The temperatures on June 18 were as follows: surface, 69° F.; at a depth of 18 feet, 67°; while the temperature was 64° at depths ranging from 27 to 37 feet. Sandy Pond falls off rather steeply on its north-west side, so that it quickly reaches a depth of from 18 to 25 feet, a depth which prevails over a large area on that side of the pond, while a little way out from the shore the depth ranges from 30 to 37 feet. On the south-east side of the pond, however, the water is comparatively shallow.

White's Pond, Plymouth: This pond has the ordinary species of fish caught in the vicinity, and in addition is reputed to have a considerable supply of carp. The bottom is mossy, and has proportionately larger areas of mud than is found in Great Sandy Pond. This pond is shallow throughout its extent, the extreme depth found not exceeding 16 feet, and for the most part being not over 5 to 10 feet. It has considerable of vegetable growth, including lily pads. The surface temperature was 71° F., while the temperature at 16 feet was 68°.

Foster's Pond, Andover: This pond was examined on July 10. The principal species of fish are pickerel, which are said to grow to a large size here, yellow perch and catfish. The bottom of the pond was so thickly covered with aquatic grass that its exact character could not be determined, though it is probable that for the most part it is muddy. The maximum depth obtained was 10 feet, but it is possible there may be small areas where the pond is a foot or two deeper. It has quantities of lily pads near the shore and in the arm that reaches toward the dam, but generally it is free from these over the greater part of its area. Surface temperature was 74° F., and 71° at a depth of 10 feet.

Martin's Pond, North Reading: This pond was visited on July 10, and such examination of it as was practicable was made. The pond is shallow, having a depth ranging from 2 to 6 feet over the greater part of its area; the maximum depth found was 7 feet. With the exception of a small patch of clear water in the centre of the pond, which probably did not exceed an acre in extent, if it was so large, the entire surface was thickly covered with lily pads to such a degree that it was difficult to row a boat through them. So far as could be determined, the bottom is soft mud over the larger part of the pond, but around the edges there are patches of gravel and pebbles. Small pickerel are said to be abundant, but large pickerel are seldom or never taken. There are also yellow perch and a few catfish or "pout." Surface temperature was 76° F., and the temperature at a depth of 7 feet was 72°.

Watuppa Lake, Fall River: This lake was examined on August 8. The lake is one of the largest, if not the greatest in area, of any body of fresh water in the Commonwealth. It is divided into two sections by a dike, over which the roadway runs, and these sections are known respectively as South Pond and North Pond, — sometimes also called Lower Pond and Upper Pond. The character of the bottom is varied. In places it is soft mud, with patches of mossy or grassy bottom, while in other sections the bottom is stony or gravelly. The maximum depth is said to be 36 feet, and the statement is made that at the bottom in some sections of the pond, where there are springs, the temperature is comparatively low. The surface temperature was found to be 74° F., and at a depth of 19 to 20 feet the temperature was 72°. The principal species of fish are black bass, pickerel, white and yellow perch, and catfish or hornpout.

Long Pond, Wellfleet: This pond was examined on August 15. The principal species of fish found there are white and yellow perch and black bass. The bottom of the pond is sandy. The maximum depth obtained was 53 feet. It is possible that there may be small areas in which the depth is slightly greater. The surface temperature was found to be 77° F., 72° at a depth of 30 feet, and 70° at a depth of 53 feet.

Gull Pond, Wellfleet: This pond was examined on August 15. It is a fine sheet of water, nearly as broad as long, and having a greater depth than any pond in the Commonwealth examined up to this time. The maximum depth obtained was 58 feet, and over a large area the depth exceeded 40 feet. The principal species of fish are pickerel, white and yellow perch and alewives. The latter come into the pond in large numbers in the spring to spawn. It has a sandy and gravelly bottom, with some lily pads near the shore. The surface temperature was found to be 73° F., 62° at a depth of 50 feet, and 61° at a depth of 58 feet.

Lake Chaubunagungamaug, Webster: This lake was examined August 23. It is very irregular in outline, with several small islands, and points jutting into the lake, and so arranged as to divide it into nearly three equal parts, connected by narrow channels. The principal species of fish are black bass, white and yellow perch, pickerel, catfish or pout and sunfish or roach. Black bass and yellow perch are reputed to be abundant, and pickerel, catfish and roach are reasonably numerous. Some fifteen hundred white perch were put in the lake about two years ago, but some doubt exists regarding any of them being there now; there is a diversity of statement concerning this. The lake has also been stocked with lake trout, but no adult fish of this species have been seen. The depth varies considerably; large areas range from 20 to 30 feet, while other sections are shallow, not exceeding 12 or 15 feet, and with comparatively high temperature. The maximum depth, 42 feet, and lowest temperature are found in that section of the lake commonly called "North Pond." The bottom is much diversified, but is generally hard, being composed of stones and gravel, though there are patches of mud and sand, and more or less greater areas are covered with aquatic grass. The surface temperature ranges from 76° to 78° F., 78° in a depth of 15 feet in one locality, 65° in 27 feet, 64° in 28½ feet, and 60° at a depth of 42 feet, in the North Pond; 70° in one place, at a depth of 31 feet, in the "Middle Pond," and 69° at a depth of 23 feet in the "South Pond." Temperatures were taken in numerous positions and at various depths in the Middle and South Pond, ranging from 69° minimum to 76° or 78° at the maximum or surface temperature. There appears to be quite a wide range of temperature at the same depth between the North Pond, so called, and the other two sections of the lake, indicating the probable presence of springs at the bottom of the northern section, with water of comparatively low temperature. The fact that the well which supplies the town of Webster with water at a temperature which, I am told, never exceeds 54°, would indicate the possibility of this, inasmuch as this well is close to the shore of the upper section of the lake.

Lake Buel, Great Barrington: This lake was examined about the middle of September. It is a fine pond, with a good depth of water in the northern section, but shallower toward its southern end. The principal species of fish are black bass, pickerel, yellow perch, bull-heads or catfish, suckers, and sunfish or roach. Occasionally a brook trout is caught through the ice in winter. The maximum depth obtained was 44 feet. At the northern part of the pond in several places the bottom falls off rather steeply to 25 or 30 feet. It is claimed that this lake is fed by springs, which accounts for the low temperature at greater depths. The surface temperature was found to be 68° F.; the temperature at a depth of 30 feet was 54°, and it was 52° in depths ranging from 42 to 54 feet. The bottom is chiefly gravel, sand and pebbles; but there are muddy spots, particularly in the southern section.

Forest Lake, Palmer: This pond was examined September 27. It is a fine large pond, with varying depths and temperatures, the latter changing considerably with depth. The principal species of fish are pickerel, yellow perch, catfish, chubs, suckers and shiners. It is said that there are very few suckers, and that now pickerel are scarce and small. The bottom is composed of gravel, stones and mud, with large areas of eel grass. The maximum depth is reported to be 64 feet, but in the examination made the greatest depth obtained was 28 feet. The surface temperature was 68° F., and the bottom temperature at varying depths was as follows: 62° at 17 feet, 55° at 27 feet and 54° at 28 feet. This pond is fed by springs, hence the low temperatures at the bottom.

Brown's Pond,* Palmer: This pond was examined on September 27. It is comparatively of small size and rather shallow, with lily pads near the shore. The principal species of fish are pickerel, catfish and yellow perch. The bottom for the most part is sandy and grassy. There is no inlet, the pond being fed by springs. The maximum depth obtained was 9 feet, but the depth generally ranges from 5 to 8 feet, except near the shore, where it is less. The surface temperature is 63° F.; the bottom temperature was 62° at 7 feet and 61° at 9 feet.

Bartlett's Pond, Northborough: This pond was examined on October 2. It is shallow throughout its extent, and over the greater part of its area it does not exceed 4 to 6 feet in depth. The maximum depth obtained was 8½ feet. Lily pads are numerous. The principal species of fish are the large-mouth black bass, pickerel, yellow perch, catfish, sunfish or roach, and shiners. It is said that, generally speaking, the fish are small in this pond; but some black bass that we saw were of good size, and would weigh from 1½ to 3 pounds each. The bottom is apparently soft mud all over the pond, with a profusion of aquatic grass or eel grass. The surface temperature was found to be 68° F., and the bottom temperature was 66° in depths varying from 6 to 8½ feet.

Solomon Pond, Northborough: This pond was examined on October 2. It is reputed to have a shallow ridge something like a bar extending across it, but generally speaking has a good depth throughout. In some places the bottom falls off steeply from the shore to a depth of 20 or 30 feet. The principal species of fish are pickerel, black bass, yellow perch, and catfish or pout. The bottom in the deepest sections of the pond is chiefly soft mud, but nearer shore there are spots of sand and pebbles. The surface temperature was found to be 69° F., while the temperatures at various depths ranged as follows: 64° in 24 feet, 54° in 30 feet and 52° in 31 feet, which was the maximum depth obtained.

Chauncey Lake, Westborough: This is a fine pond with beautiful surroundings; it has a large area of nearly uniform depth, varying from 19 to 20 feet. The principal species of fish are black bass, pickerel, catfish and yellow perch. It is said that both large-mouthed and small-mouthed black bass are taken here. It is also stated that five thousand young land-locked salmon were put into the lake in 1900, but there is little probability that they will thrive in water with a temperature as high as this pond has. The bottom is varied. Near the shore there are large patches of gravel, stones and pebbles, but in the deeper part of the pond the bottom appears to be largely soft mud. The surface temperature was 67° F., and the bottom temperature was found to be as follows: 64° to 66° at 19 and 20 feet in depth.

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* A petition was presented to have this pond stocked and the fishing therein regulated, in accordance with chapter 208, Acts of 1897. Subsequent to the examination, however, it was ascertained that the pond was less than 20 acres, and therefore private property, not available for State action.

Fort Pond, Littleton: This pond was visited on October 16. The principal species of fish are pickerel, yellow perch, pout or catfish, roach or sunfish, and shiners. With the exception of yellow perch, fish are generally scarce, though the pickerel that are taken are reputed to be of good size and condition. The scarcity of the fish is attributed to depletion caused by winter fishing through the ice. In some parts of the pond the bottom is composed of sand, gravel, pebbles and stones; but over a large area in the deeper parts the bottom is soft mud. The surface temperature is 62° F., and the bottom temperature at various depths was as follows: 60° at 22 feet, 59° at 25 feet, 55° at 32 feet and 54° at 33 feet. It is claimed that the maximum depth of the pond is 40 feet, but no depth was obtained in the examination made greater than 33 feet.

Little Herring Pond, Plymouth: The same species of fish found in Great Herring Pond occur in Little Herring Pond; but in the latter the conditions are specially favorable to pickerel, which are consequently much more abundant than they are in the larger pond. In walking along the side of Little Herring Pond the chairman of the commission saw several pickerel near the shore and large numbers of tadpoles, while not a few specimens of the large bullfrog were observed. The bottom in Little Herring Pond is similar to that in Great Herring Pond, though possibly there are proportionately larger areas of mud. The water is shallow, and lily pads are abundant near the shore. The surface temperature was 69° F.

Ezekiel's Pond, Plymouth: This pond was visited on June 18, but, owing to lack of a boat, could not be satisfactorily examined. The principal species of fish are black bass, pickerel and yellow perch, and it has the reputation of producing large bass. According to Captain Godfrey, it was stocked with landlocked salmon in 1896, but none have ever been taken, so far as can be learned. The bottom is sand, gravel and pebbles, and the extreme depth is said to be about 20 feet. The surface temperature was found to be 71° F.

Big Rocky Pond, Plymouth: This pond was visited on June 18, but, owing to lack of a boat, could not be thoroughly examined. According to those familiar with it, it has quantities of small black bass, but bass do not grow large in the pond. The bottom is composed of sand, gravel and pebbles, with occasional large stones or boulders. Both Big Rocky Pond and Little Rocky Pond, the latter being in the near vicinity of the former, are noted for boulders or ledges of considerable size, and because of this fact, which is somewhat rare in this vicinity, they have received their names. At the point visited on Big Rocky Pond the beach fell off very gradually, and the surface temperature in the shallow water over white sand was 73° F., which is doubtless more than it would have been in deeper parts of the pond.

Little Sandy Pond, Plymouth: This pond was visited on June 18, but could not be examined, owing to lack of a boat. It is rather shallow, and is reputed to be a fine pickerel pond. It has sandy shores, and the bottom is probably similar to that of the other ponds in the near vicinity.

Long Duck Pond, Plymouth: This pond was not visited, but is reputed to be shallow with "mossy bottom," and with very few fish in it.

Round Pond, Palmer: This pond, which was stocked in the spring of 1901 with pike perch, was visited on September 27, but the depths and temperatures could not be ascertained, owing to the fact that no boat was available for this purpose. The pond is reputed to have a maximum depth of 25 to 30 feet, and a comparatively low temperature at the bottom, due to the fact that it is fed entirely by springs. The bottom, so far as can be judged by the shore, is composed chiefly of gravel and pebbles.

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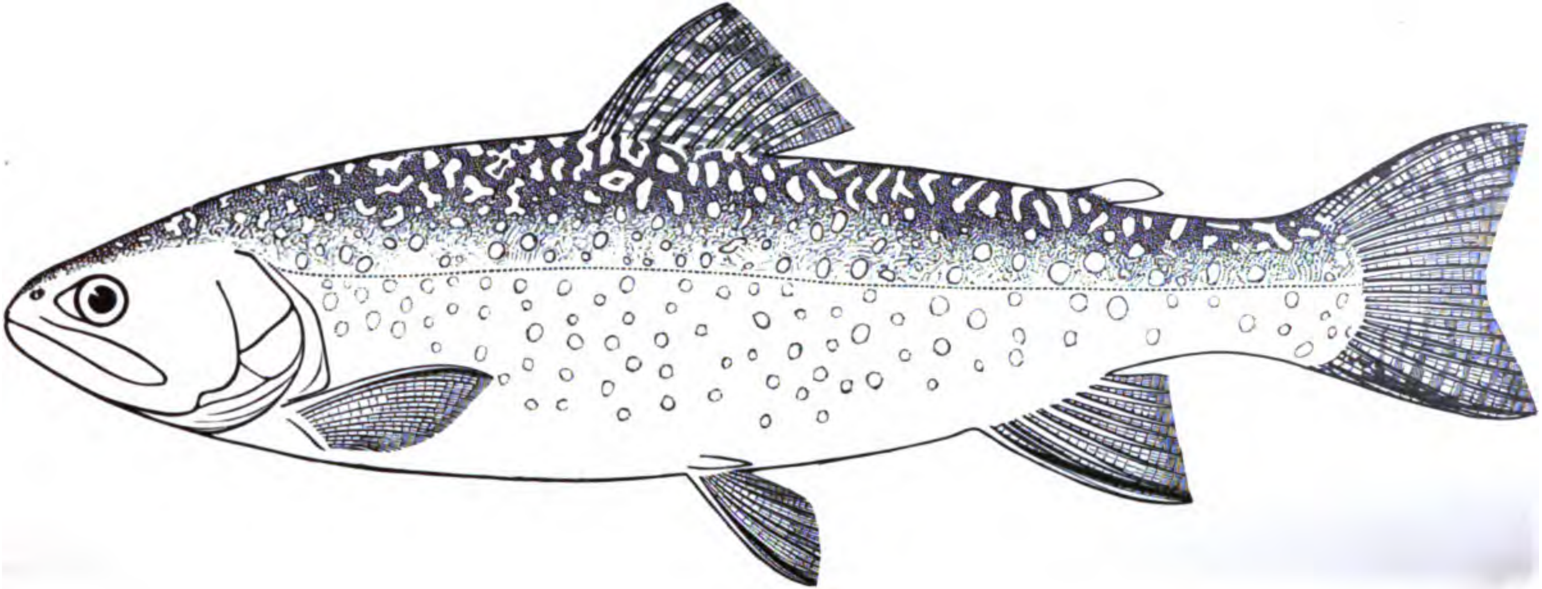

BROOK TROUT.—*Salvelinus fontinalis.*

Little Chauncey Pond, Northborough: This pond, which was seen but not examined on October 2, is approximately the same size and character as Bartlett's Pond, it being shallow, and presumably the water is of the same temperature, as the two ponds are connected by a brook.

Work of the United States Fish Commission. — The fish-cultural work prosecuted by the United States Fish Commission, at Wood's Hole and Gloucester, during the period covered by this report, has assumed large proportions, and is second only to what was accomplished last year. There has been a marked falling off in the production of lobster fry, due to the difficulty experienced in the obtainment of egg-bearing lobsters in the waters of this State, but the number of fry planted off our coast slightly exceeds the total of last year, for the reason that 12,970,000 fry, that were hatched from eggs obtained in other States, were liberated from Cape Ann to Cohasset. Thus the total output of fry of this species in Massachusetts waters has been 37,210,000, against 37,181,000 fry planted off our shores last year.*

A total of 202,871,000 cod fry and 44,230,000 flatfish fry have been deposited in the coast waters of Massachusetts during the year.

The total output in our coast waters for the current year, of lobsters, cod and flatfish, was 284,311,000 fry.

The following statement, furnished by the United States Fish Commission, shows in detail the quantities of fish produced at the two stations, and the allotments for distribution at various points along our coast line: —

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* A more detailed statement relating to the artificial propagation of lobsters, etc., will be found under the head of "Lobster culture and lobster fishing."

Statement of Fish deposited in Massachusetts Coast Waters by the United States Commission of Fish and Fisheries during the Season of 1901, not including the Lobster.

SPECIES AND DISPOSITION.	Number of Fry.
Cod.	
Vineyard Sound: —	
At its mouth,	1,406,000
Off Robinson's Hole,	4,869,000
Off Tarpaulin Cove,	36,106,000
Off Job's Neck,	27,693,000
Off Gayhead,	15,370,000
Off Waquoit,	4,020,000
Off Lackey's Bay,	7,155,000
Off Can Buoy,	3,271,000
Atlantic Ocean: —	
Gloucester,	96,541,000
Beverly,	3,925,000
Eel Pond, Wood's Hole,	1,558,000
Green Pond, Falmouth,	957,000
Total,	202,871,000
Flatfish.	
Wood's Hole Harbor: —	
Off Wood's Hole,	32,495,000
Off Grassy Island,	1,527,000
Off Lackey's Bay,	585,000
Green Pond, East Falmouth,	3,313,000
Great Pond, East Falmouth,	1,523,000
Vineyard Sound, Lambert's Cove,	1,681,000
Hadley harbor, Naushon Island,	2,668,000
Acushnet harbor, New Bedford,	438,000
Total,	44,230,000

The magnitude and importance of this work must be apparent to all who have given the matter any consideration, and who are thus able to estimate its true value as a factor in contributing to the maintenance in our coast waters of species which support large commercial fisheries. With the rapid development of our country and the acquirement of insular possessions with fish-eating populations, whatever tends to keep up the supply of food fish, and thereby to promote our fishing industry, cannot be lightly esteemed by the citizens of this State.

Reference will be made elsewhere to the eggs of fresh-water species contributed by the United States Fish Commission to this State for stocking inland waters.

Fishways. — Much effort has been put forth in the examination of fishways built, rebuilt or repaired, under orders issued last year, and also in examining dams or other sites for new fishways. In many instances the chairman and superintendent of hatcheries have visited fishways or sites together, and in other cases the examination has been made by one of them. Among the completed fishways inspected were the following: —

The new fishway at Middleborough, which, it will be remembered, was extended twenty feet last year. We observed alewives passing through it to the pond above in considerable numbers, and concluded it was furnishing a satisfactory passageway for these fish, notwithstanding contrary statements received by the commission.

The fishway at East Taunton, which was rebuilt last year, is in good condition.

The fishway at the outlet of Mill Pond, in Yarmouth. Mill Pond has been appropriated by the State for the obtainment of a supply of white perch with which to stock other ponds. Some alterations were needed in this fishway. These were made, so that fish can pass through at different stages of water. This is necessary, since the water above the fishway may be raised materially when the cranberry bogs are flowed.

The several small fishways at and near Santuit Pond.

Two small fishways in the outlet of Mashpee Pond, built early in the present year. They were most effective. Alewives were running through them in such numbers that children were catching the fish in their hands.

Orders for building fishways have been issued to the following parties this year, and in each case a personal examination of the site was made by one or more of the commissioners.*

The Acushnet Sawmill Company, Acushnet. The stream which furnishes the power to operate the mill of this company, and which has been dammed for that purpose, is one that has been frequented from time immemorial by alewives in spring, when they are seeking their natural spawning grounds. It was found possible to construct what may be termed a natural passageway for fish, with comparatively small outlay; and the company very readily agreed to prepare it, and have it in an efficient condition before the spring migrations begin next year.

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* This enumeration does not include the two fishways built in Mashpee, to which reference has already been made. Plans for building these were made by the commission, on request, but no order for their construction was issued.

Mr. James B. Hamblin, whose mill is situated on the same stream, a short distance above the mill of the Acushnet Sawmill Company.

Mr. O. H. Howland of Sandwich, who controls the sluiceway at the outlet of Little Herring Pond. This sluiceway is for the purpose of raising the water over the cranberry bogs between Great and Little Herring ponds, and therefore serves to prevent the free passage of migratory fish into the smaller pond, because the bogs are often, if not generally, flowed during the migratory period.

No occasion has been found for building any fishways by the State, under chapter 344, Acts of 1900, consequently the money appropriated for that purpose has not been drawn upon.

Prevention of Stream Pollution. — The effort to enforce the law (chapter 129, Acts of 1890) for the prevention of stream pollution, which results from the unrestricted discharge of sawdust into trout streams, has been continued. In pursuance of this work, many mills and streams have been personally visited by the chairman. Among these were a number of mills the owners of which had been notified last year, but, as a result of a hearing held by the commission, the enforcement of the orders was temporarily suspended until it was practicable for the chairman to visit the mills. The examination made indicated the desirability of prohibiting the discharge of sawdust from these particular mills, with one exception, and new orders were issued accordingly. One mill in the vicinity which had previously not received any attention was also examined, but its location and environment did not warrant any action, since the little stream it was located on was not a trout brook, and emptied into a pond about a quarter of a mile or less from the mill.

Orders have been issued this year to twenty-four mill owners, as will be seen by the list that follows, and similar orders were issued last year to fifteen owners. Inasmuch as some individuals or firms own more than one mill, the mills thus affected somewhat exceed in number the orders issued. Thus, in the period covered by this report the orders sent out applied to twenty-six mills at least, and forty-one mills have been stopped from discharging sawdust into streams in 1900 and 1901.

Orders were issued to the following owners of sawmills in 1900: L. J. Hall, Charlemont;* Reed & Temple, East Princeton; Edward Pawrant, Hoosac Tunnel P. O.; G. H. Mann, Zoar; Stafford, Whitcomb & Co., and W. L. Allen, Monroe; William Henry, Clarksburg; William Putnam, Millington; Eugene Bullard, North New Salem; Irving T. Hale, Hubbardston; Diamond Match Company, Athol; Joseph Williams, Warwick; Edwin Wallace, Southbridge; Triming & Wilcox, New Boston; and Henry Bassett, Charlemont.

Orders prohibiting the discharge of sawdust were sent to the following mill owners during 1901: Andrew Bartlett, Dwight; Goddard & Williams, North Orange; C. H. Gale, Orange; Leonard Moulton, Petersham; Marshall Stedman, Tyringham; George Thomas, West Becket; Harry Crossman and Rufus H. Fitts, Cushman; A. P. Bates, E. S. Snow, Sanford & Stebbins, and Pratt Brothers, Belchertown; Harry B. Bond, South Belchertown; Albert J. Baker, Shutesbury; E. W. Cady, Dalton; D. A. Cady, Windsor; George A. Stevens † and F. Brochu, New Marlborough; S. S. Richardson, Charles Billings, Rice E. Soaper, Wesley Watson, C. N. Watson and Emmons Dudley, Montague and Leverett; and S. W. Bowen,‡ Wendell.

Naturally there is more or less objection to the enforcement of this sawdust law, and it may not be wondered at that mill owners, who at best find their business not any too remunerative, cannot see that the maintenance or increase of trout in a brook is of sufficient consequence to warrant any action on the part of the State which may interfere with privileges that have been long enjoyed, and thus to cause them some trouble and expense. As a rule, the claim is made that there are no trout in the brooks, or at least not sufficient to justify any limitation or prohibition of the discharge of sawdust; and occasionally the argument is advanced that the emptying of large quantities of sawdust into streams is most beneficial to trout, which thrive and grow more abundant because of it. It is scarcely necessary to seriously consider the last-mentioned claim. As to the other assertion, a single instance may properly be cited.

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* It was learned that Mr. Hall had a blower, but the sawdust was gathered in a heap on the bank of the stream, and often fell into the brook.

† Mr. Stevens had two mills, one at Hartsville P. O., and a steam mill higher up on the same brook, which discharged sawdust into the stream upon which they were located.

‡ The last seven persons named are the owners of mills concerning which orders were suspended last year.

Last year the statement was made that a certain brook in the northern central part of the State,* upon the bank of which a sawmill was located, was of little or no practical value as a trout stream. From observations made by the writer a different conclusion was reached, and orders were sent to the mill owner to take such means as were necessary to keep his sawdust out of the brook. It is believed that the order was faithfully observed. Early in last July two well-known anglers from a neighboring town caught in a short time one day thirty-three brook trout, which ranged in size from nine inches to a weight of one and one-half pounds. Both of these men had fished the streams of Maine and New Hampshire, and one of them, who recited the above facts to the writer, declared neither of them had previously taken such fine strings of brook trout. It is quite within the possibilities that it would not have been practicable to secure such results the year previous, not far below the mill, and it is equally possible that considerable improvement to fish life may have resulted even in one year from keeping the stream free from pollution.

Fisheries.

Importance of Commercial Fisheries. — In our last report statistics were presented showing the importance of the sea and shore fisheries of Massachusetts, and the position held by this State in comparison with other New England States. It is somewhat remarkable, perhaps, that, despite the reverses which have come to the North Atlantic fisheries in the past half-century, Massachusetts not only has invested at this time two-thirds of the capital that New England has employed in these industries, but she still ranks as the premier fishing State of the Union, so far as her invested interests and the value of products are concerned. Nor should it be forgotten that she sends forth from her harbors by far the largest fleet of deep-sea fishing vessels that exists in the United States; that these vessels are unrivalled elsewhere in the fisheries of the western world; that they explore all oceans, from the frozen regions of the Arctic and Antarctic to the tropics, to gather the harvest of the seas; and that this fleet is a school for the training of seamen that will grow increasingly important as our national aspirations for sea power and maritime commerce develop.

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* The name of this brook is withheld from publication for the present, because there is no doubt it would be very much overfished, and its chances of being restored to a first-class trout brook might be injured, if not destroyed, if its name and location were given in connection with other statements of fact made here.

In view of all this, there is reason for satisfaction in the general prosperity that has been experienced, even if the result in some branches has not been so good as was hoped for. A ready demand for products and good prices have ruled, and, generally speaking, the financial returns have been far above the average. The inauguration of new and improved methods, and a wider adoption of some already tried, indicate a progressive spirit which promises to add materially to the prosperity and consequence of our ocean fisheries.

It is gratifying to record that suggestions made by this commission for improvements along certain lines have been readily adopted. The importance of this action can scarcely be properly estimated at this time, but there can be no question that it will prove of great benefit to the fisheries, and will help to keep this State in the van, so far as these industries are concerned.

Statistics. — For the first time in the history of this commission is it practicable to publish figures, relating to certain of the shore fisheries, which have any statistical value. This is due to the law passed at the last session of the General Court, which makes it possible to show the number of individuals employed, the number and value of boats and each kind of apparatus, and, what is of still greater consequence, the quantities and values of products. Heretofore, as will be remembered, the law called for the numbers of fish only, and, inasmuch as there is always liable to be a wide variation in their size and weight, especially of certain species, it was impossible to do more than to guess wildly at the quantity (in pounds) taken from year to year; thus the figures obtained heretofore were practically valueless, so far as affording any basis for intelligent conclusions regarding the importance or value of the fisheries to which the statistics applied.

Some trouble has been experienced in making certain of the fishermen understand how to submit their returns in accordance with the new law. This was anticipated, however, and it may reasonably be expected that, when once they have learned the new method, which is surely simple enough, and when it is understood that all fishermen operating certain forms of apparatus, which the law enumerates, must comply with the law, no difficulty whatever is foreseen in the collection of reliable and satisfactory statistics of our coast net and trap fisheries. Indeed, it will be the effort of this commission to make the figures thus collected as nearly accurate as possible; for it is well known that the data secured in the ordinary personal canvass for fishery statistics, which must unavoidably depend in large measure solely upon off-hand estimates, — often the wildest sort of guessing, — can scarcely be deemed either reliable or satisfactory.

Shore Weir and Net Fisheries. — Again the mackerel has failed to approach the coast in large numbers; it has instead frequented the off-shore fishing grounds, as it did last year. Consequently, there has been disappointment with the season's fishing with pound nets, weirs, traps and gill nets.

Cape Cod bay is the region most seriously affected by the failure of the mackerel to strike inshore, for the pound-net or weir fisheries are most important there, and the mackerel being relied upon more than any other species for success, its abundance or absence are matters of prime consequence to the fishermen. It is true the loss resulting from the scarcity of mackerel along our shores has in part been made up by the abundance of other species, notably the squeteague. But this scarcely satisfies the fishermen, who attribute the absence of the mackerel to the presence of the squeteague in such large numbers; hence they fail to appreciate the latter, the abundance of which has often caused it to be a drug in the trade and marketable only at a loss, and doubtless they would be glad if it left the waters north of Cape Cod, as in former years.

The tables published in the Appendix show in detail the statistics of the fisheries included under this head; but, owing to the fact that similar figures have not previously been presented, it is not practicable to institute comparisons with other years, except so far as lobsters and lobster traps are concerned. It can only be said that the fisheries here considered were not generally prosperous, or at least less so than was anticipated or hoped for.

The appearance of a large body of squid in Cape Cod bay late in the season was an advantage to the weir fishermen, though not sufficient to counterbalance the scarcity of mackerel or the failure of the fall run of herring. Mr. I. M. Small of North Truro, in a letter dated Oct. 26, 1901, makes the following statement: "We are having an immense run of squid in the bay, — something far beyond all record. They have been running on to the beach in such numbers that about fifty barrels were gathered up by men and boys on the shore last night, and found ready sale at the cold storage at $1 per barrel." But this was after the season covered by this report, and, even if the squid had arrived sooner, the profit derived from the capture of this important bait species was not sufficient to make up for the light catch of mackerel or other high-priced products, or the failure of the fall catch of herring.

The cause of the scarcity of the mackerel in its usual haunts in our in-shore waters, and its persistence in remaining off shore on the deep-sea fishing grounds, is one of those questions concerning which there is much conjecture and a wide divergence of view. All that can now be said with certainty is that this action is in harmony with the well-known and widely recognized erratic habits of the mackerel, which is so unreliable in its movements, abundance, etc., that what it does one year seems to be no basis whatever to judge by as to its presence or migrations the next season. The general subject is an interesting one, but lack of time and space forbid any consideration of it here.

Lobster Culture and Lobster Fishing. — From year to year, for a long period, the reports of this commission have invited attention to the lobster, and it has been pointed out how the lobster was decreasing in the waters of this Commonwealth. The necessity for more stringent and effective legislation, to arrest this decadence, has repeatedly been urged upon the General Court. It is true that something has been done to secure protection, but it is too evident that much yet remains to be accomplished, unless citizens of this State are content to see the lobster become commercially extinct along our coasts, and that within a measurably brief period, — so short a time, in fact, that we now seem to be almost on the verge of it. It is nothing less than blind folly to ignore this, and, if future legislation fails to recognize it, or grants greater freedom in fishing, it will not be difficult even for the non-expert to predict the ultimate result.

No longer is there justification for deluding ourselves with the belief that the artificial propagation of the lobster can arrest its decadence in this State to any great degree, and the chance of doing this grows alarmingly less every year. It is well known that the United States Fish Commission has made a most zealous and commendable effort to stem the tide. It has spent both money and labor to restock our waters with lobsters, and has in recent years done all in that direction that seemed possible of accomplishment. It has not been stinted in means, and, though it has been working for the benefit of the fishermen, it has paid full market price or more for every obtainable egg-bearing lobster, so that as many as possible could be secured. And right here let it be said that the lobsters produced from the eggs thus secured are that many added to the natural production, for, if the females were not purchased by the commission, the eggs would in most cases be stripped from them, and they would be sold for food. And it may be added that the female lobster, after being stripped by the spawn takers of the commission, is thrown into the sea, so that it may produce eggs again, if it escapes the fisherman's pot and the market.

The following reports from the superintendents of the Gloucester and Wood's Hole stations show in detail what has been accomplished this year at those points in the artificial propagation of the lobster, and incidentally make known to us the serious decline in the numbers of eggs that were obtained, as compared with last year: —

U. S. Commission of Fish and Fisheries,
Gloucester, Mass., Oct. 28, 1901.

Capt. J. W. Collins, *Chairman, Board of Commissioners on Fisheries and Game, Boston, Mass.*

Dear Sir: — I submit herewith a report of the lobster hatching operations at Gloucester, Mass., station during the season of 1901.

The season opened under adverse conditions; the continuous stormy weather during April and the early portion of May practically put a stop to lobster fishing in this vicinity, and made collections of egg-lobsters impossible. It was not till May 11 that we received the first egg-lobsters, from which date collections were made till July 10. The field of collecting operations in Massachusetts took in the principal fishing centres between Cape Ann and Cohasset.

In spite of every effort made to make the collections as large as possible, the season's receipts showed a decrease of about 25 per cent. from those of the previous season. This decrease, however, is entirely accounted for by the great falling off of the collections made from the Boston lobster dealers, which was 50 per cent. less than the previous season. The collections made directly from the fishermen show a slight increase over the previous season. The total receipts from Massachusetts amounted to 1,639 egg-lobsters, which yielded 21,203,000 eggs, from which were hatched 19,300,000 fry. These fry were distributed at various points along the shore, from Cape Ann to Cohasset, as were also 12,970,000 fry obtained from eggs taken outside the State, making a total of 32,270,000 fry planted in Massachusetts waters.

As in previous seasons, collections were made in New Hampshire and Maine, amounting to 30,010,000 eggs, from which were hatched 27,970,000 fry.

Very respectfully, C. G. Corliss,
Superintendent.

U. S. Commission of Fish and Fisheries,
Wood's Hole, Mass., Oct. 18, 1901.

Capt. J. W. Collins, *Chairman, Board of Commissioners on Fisheries and Game, Boston, Mass.*

Dear Sir: — In accordance with the request contained in your letter of the 15th instant, I beg leave to submit the following brief report of the work done in propagating lobsters at this station during the season of 1901.

Operations were conducted on practically the same lines as during the past few years. Collections were made at Scituate and Plymouth on the north side of Cape Cod, and from the territory included in Vineyard Sound and Buzzard's Bay.

The receipts in eggs were very discouraging, being the smallest we have known for several years, even though the price offered the fishermen for the egg-lobsters was the highest ever paid. The total number of eggs received from Massachusetts waters was 5,476,000, being less than 50 per cent. of the number collected from the same territory in 1900. One-third of these eggs were received from the fishermen at Cuttyhunk. These eggs produced 4,940,000 fry, which were liberated in the waters of this State.

As in former years, collections were made from Connecticut and Rhode Island waters, the total number of eggs received at the station during the season being 18,262,000. From these were hatched and planted 13,945,000 fry.

Yours very truly, E. F. LOCKE,
Superintendent.

Although the foregoing reports show a trifling increase in the number of lobster fry deposited in Massachusetts waters, as compared with last year, it will be observed that nearly one-third of these were obtained from eggs collected in other States; to that extent this Commonwealth was benefited. At the same time, it will be noticed that the falling off in eggs and fry obtained from lobsters taken in the coast waters of this State was very marked, amounting to more than one-half at Wood's Hole and to one-quarter at Gloucester. The following tabulated statement presents the comparative figures with exactness: —

Table showing Comparative Statistics of Lobster Culture by the United States Fish Commission at the Massachusetts Coast Stations in 1900 and 1901.

	1900.	1901.	Percentage of Decrease.
Number of egg-lobsters, . . .	2,828	2,045[*]	27⅝
Eggs obtained, ...	40,231,000	26,679,000	33
Fry hatched, ...	36,449,000	24,140,000	34

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[*] Inasmuch as the number of egg-bearing lobsters obtained for the Wood's Hole station has not been stated by Superintendent Locke, they have been roughly estimated at one-half the number of the previous year, which is no doubt a close approximation to the actual number.

When we see a decline in one year of nearly 28 per cent. in the number of egg-bearing lobsters it has been possible to obtain, a decrease of 33 per cent. in eggs, which indicates a decreasing yield per lobster, and a falling off of 34 per cent. in the number of fry hatched from Massachusetts eggs, the condition, so far as the artificial culture of the lobster is concerned, is one that is not encouraging, to say the least. But if we carry the comparison farther back, we obtain results still more impressive, if not startling. In 1894, only seven years ago, it was practicable to secure for the Wood's Hole station, with less effort than is now put forth, 97,635,000 lobster eggs, while this year only 5,476,000 could be gathered. If, then, authorized statistics prove that decadence has been so great in seven years that, roughly speaking, there is only one-nineteenth of the egg-bearing lobsters now in the southern section of the State that there were in 1894, and only one-half as many as last year, it is evident that we are approaching the time when breeding female lobsters will be almost exterminated from our waters, and when it will no longer be possible to carry on lobster culture upon a scale sufficiently large to have any considerable influence upon the continuance of the species. When that time arrives, the skill of the fish culturist and generous appropriations of the federal government will alike be unavailing to restore the lobster, unless efficient measures are taken to regulate and control its capture.

It is not, however, alone in the fish-cultural work of the United States Fish Commission that evidences are found of a marked decrease in the lobster off our shores. The statistics gathered by this commission show that there has been a decline of 24 per cent. in the catch per pot since last year, — and it is the average catch per pot which shows, more clearly than anything else can, the actual relative abundance of the lobster.

The following tabulated statement, from returns received by this commission, shows very clearly the decrease of the lobster fishery in this State during the past fourteen years: —

Comparative Table showing the Statistics of the Lobster Fishery in Massachusetts, 1888 to 1901.

DATE.	Fishermen.	Traps.	Lobsters.	Egg-bearing Lobsters.	Average Catch per Pot.
1888, ...	367	21,418	1,740,850	-	81
1889, ...	344	20,016	1,359,645	61,832	68
1890, ...	379	19,554	1,612,129	70,909	82
1891, ...	327	15,448	1,292,791	49,973	84
1892, ...	312	14,064	1,107,764	37,230	79
1893, ...	371	17,012	1,149,732	32,741	62
1894, ...	425	20,303	1,096,834	34,897	54
1895, ...	377	17,205	956,365	34,343	56
1896, ...	453	22,041	995,396	30,470	45
1897, ...	388	18,829	896,273	23,719	48
1898, ...	340	16,195	720,413	19,931	44
1899, ...	327	15,350	644,633	16,470	42
1900, ...	309	14,086	646,499	15,638	46
1901, ...	331	16,286	578,383	16,353	35

Additional verification of decrease in catch is found in personal statements, both written and verbal, that come to the commission from fishermen, sea-shore residents, dealers and others who have had opportunities for observation.

This condition is, however, nothing more than may be expected, having in mind the general disposition to ignore protective laws, even at much risk. The experience through which Massachusetts is now passing is common to all lobster-producing regions, except where there are stringent repressive laws, well enforced. New Jersey, New York and Connecticut no longer possess a lobster industry of any importance, and even in Newfoundland, where lobster fishing was inaugurated on a large scale only a few years ago, there is complaint of a rapid decline in abundance.*

According to the latest report of the Newfoundland Department of Fisheries, there has been a marked falling off in the catch of lobsters on the coast of that province very recently. This report shows that the average annual exportation of lobsters in the two years preceding 1900 amounted to 63,558½ cases, while in the latter year, so far as could be ascertained, it fell off to 36,894 cases. "This falling off," remarks the minister of marine and fisheries, "which we share in common with other lobster-producing countries, shows the urgent need of increased efforts to lessen the decline, and the utmost vigilance in enforcing existing rules and regulations, so as to conserve, as far as possible, this valuable industry."

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* In 1887, when the writer was at Seldom-Come-By harbor, on Fogo Island, east coast of Newfoundland, a local fisherman brought alongside the "Grampus" a lot of fine lobsters which he had gaffed from under the half-submerged rocks just beyond low-water mark. Where the lobster was sufficiently abundant for this to be done only fourteen years ago, it is now scarce.

It would appear from this report that Newfoundland is passing through an experience similar to that which has come to all lobster-producing sections of North America; and the fact that its fisheries did not sooner show evidences of an alarming decadence is due solely to the fact that the establishment of the lobster industry in that province is a matter of such recent date. It has already been found necessary to apply a close season, in order to prevent the ruin of the lobster-packing industry.

"Considering the importance of the lobster fishery to the colony," says the report, "and the large number of people dependent to a considerable extent on this industry, the importance of protecting and regulating it becomes apparent to all. Two years ago the condition of this fishery was sufficiently alarming. The size of the lobsters was reported to be diminishing and their number decreasing in many places, as a result of over-fishing and taking of immature lobsters before they had reached their spawning age. A stringent application of carefully considered rules and regulations, and the entire prohibition of fall fishing have had a salutary effect in improving matters and placing this industry in a healthier and more hopeful condition. . . . The board are satisfied that the abolition of fall fishing has been especially beneficial, and that its enforcement in the future is most desirable. Opposition to this measure, once so strong, has now almost ceased and both packers and fishermen appear to be almost unanimously in favor of the rule."

What can be done to arrest the decline of the lobster and restore its abundance in our waters? That is the important question which now challenges the reasonable and intelligent consideration of every citizen who has an interest in this matter, and especially should it have the thoughtful attention of those who are not influenced by any motive or desire but to secure conditions which will promote the public welfare.

It has been demonstrated that present laws, with inadequate means for their enforcement, cannot accomplish all that is desired or necessary. While arrests have been made and convictions have been secured, and the records show that 1,490 short lobsters and 19 egg-bearing females have been restored to sea by the deputies of this commission, it is not within the limits of human possibility for only three or four deputies, working in pairs, whenever possible, to keep under observation all the lobster fishermen and dealers along our extensive coast line. Present laws are helpful, but they are insufficient, and there seems to be a wide-spread demand for additional restrictive legislation. The common suggestion is for a close season; but ideas as to what a close season should be are as various and numerous as the individuals who advance them, thus showing lack of unification of purpose. Still, the very fact that suggestions of this nature have come spontaneously from so many, without the knowledge of each other, indicates most forcibly the prevailing thought and the need of action of some kind, while the character and extent of the action which it will be wise to take may possibly be arrived at by a full consideration of all the purposes to be served. Following are a few extracts from letters received by the commission, which deserve attention in this connection, since they not only show the desires of the writers (most of them fishermen) for greater restrictions, but also indicate the deplorable condition of the lobster fishery: —

Mr. H. P. Taylor of Brant Rock, in submitting his return for lobster fishery for 1901, makes the following statement: "After forty-two years' experience in the lobster fishery, I, as an individual, would propose to have a close season from the first of June up to the first of August for three years."

Mr. George F. Freeman of South Duxbury, in submitting the report of his lobster fishery, makes the following statement: "I am driven right out of the business, and have sold out everything this spring. It seemed hard for me to heave overboard twelve and fifteen short lobsters out of every pot, and the next one put them into his boat. I could not stand it any longer. Short lobsters have been caught here all summer, and I hope and pray that you will make a close season, and stop fishing in bays. A lobster here next season, 1902, will be a curiosity. You will never stop this short lobster business until there are different laws made. I propose a close season from the first of April until the first of August, and close the bays so a lobster will have a chance for his life. But I am through with it, and do not care."

Mr. George Wheeler of Dennis, Mass., in submitting his report says: "The lobster is fast being wiped out. Our stringent laws seem to have little effect on most fishermen. . . . I love the water and lobstering, but I sincerely hope you will succeed in having a close season for at least three years."

Mr. H. E. Dunham of Nantucket says: "Lobsters have been very scarce around here this year. They have dropped off 50 per cent. every year for the last five years. I think the only way to save the lobster is a close season for five or ten years."

Deputy Burney in his report for the week ending July 7, makes the following statement relative to the scarcity of lobsters along the north shore of Massachusetts Bay: "In my trips along the coast I find a large number of fishermen have taken up their traps, owing to the great scarcity of lobsters. Those whom I talked with tell me it does not pay to bait and haul fifty traps, and find only eight or ten small lobsters."

Mr. I. M. Small of North Truro, ex-member of the Legislature, writing on Oct. 26, 1901, advocates a close season, in the following words: "I am glad to see that the lobster agitation of last winter is showing thus early some indication of bearing fruit, in the proposition for a close season. My action at the last session in voting for the nine-inch bill, as I think I have stated to you before, was influenced mainly in the belief that such action would sooner bring about the only remedy, namely, a close season. The lobster can never be protected by limiting the length; men must stop catching the fish, totally; and I am personally against a close season of anything less than five years. If people expect in the future to enjoy the lobster, they must forego the luxury for a considerable period. If we expect this shellfish ever to be plentiful again in our waters, we must begin at once to make provision for it. We must stop catching them altogether, or expect to see them extinct in the near future. A close season of a few months will meet with difficulties of enforcement, just as the present length limit does. The protection must be made so strong as to demand that for the present the business shall be entirely abandoned."

On Aug. 12, 1901, Mr. C. V. McMahan of Vineyard Haven returned the lobster blank sent him, with the following remark: "I am not fishing for lobsters this year, so I will return the blank. Those that are fishing for lobsters do not catch enough to pay them."

The only protest against a close season received by the commission comes from Provincetown, where the fishermen, while realizing something should be done to stay the decadence of the lobster, claim that a close season that prohibits summer fishing would cut them off entirely from participation in the industry, due to the fact that the lobsters they catch come in from sea in May and depart in September. This claim is doubtless well founded, as is also the claim that small lobsters are rarely taken at the tip end of Cape Cod. This would of course present no obstacle to a close season for a term of years. But it is probable that a close season for a certain number of months each year, if legislation of this kind is attempted, will meet with less opposition, and will give wider satisfaction than absolute prohibition of fishing for a term of years. And, if an annual close season is made to cover the months when the lobster is most in need of the protection that can be derived from a prohibition of fishing, if the present laws are also retained or better ones enacted, and adequate provision is made for their enforcement, there is reason for believing much can be done to stay the decadence of the lobster, and possibly to increase it, in our waters.

It is evident, however, that a close season for a term of months each year, if it is to be effective, should include at least a portion of the time when the female lobsters are carrying their eggs, also the spawning period and the shedding season. This would certainly embrace the period during which lobster fishing is prosecuted at Provincetown, if no longer; for the spawning and shedding seasons, having in mind the time for the shells to come hard, cover the full period from May to September. And this is the time, it may be incidentally remarked, when the bulk of the short lobsters taken are disposed of; it is then that more is done to deplete the lobster and to destroy the fishery for it than can be done at any other period of the year. For a portion of the time, too, the lobster is molting, and during its soft-shelled period it is unfit for food. Generally the fishermen are compelled to keep their pots out of the water for a greater or less length of time in mid-summer, because of this.

It is true, if fishing is prohibited at this season, it would not be practicable for the United States Fish Commission to continue lobster culture in this State, except the eggs are obtained elsewhere. But this need cause no anxiety, for man cannot improve upon nature, if the female lobster is undisturbed during its breeding season; the only proper reason for artificially hatching lobsters is to save what otherwise might be lost, and this is the motive that has controlled in this work.

Reference is made to the report of Dr. George W. Field and to the statistics of the lobster fishery for additional facts bearing on the matters discussed under this head. The suggestions offered by Dr. Field for the protection of adult lobsters as a means to continue the species deserve attention. Assuming that enough of the immature lobsters to increase the adult supply may each year escape the fishermen's pots, and attain a size which will exclude them from capture, and also assuming that the law he proposes can be efficiently enforced, the radical change in protection which he advances may prove advantageous. Some practical difficulties suggest themselves in the administration of the law, but it is possible these may be overcome.

Cultivation of Clams. — Attempts were made at the last session of the General Court to secure some kind of legislation which would authorize the cultivation of the clam (*Mya arenaria*) under the protection of law. Some of the bills introduced aimed to secure private ownership and control of certain areas of clam-producing flats, and one had for its object the cultivation of clams by the State. The latter contained the following provisions: —

SECTION 1. The commissioners on inland fisheries and game are authorized and directed to carry on the cultivation of the soft shell or long neck clam upon such areas of flats as they may select from time to time for that purpose: *provided*, that any flats so selected shall not exceed one-third the area in any town where transplanting or other work necessary to the cultivation of clams is undertaken.

SECTION 2. In the pursuance of the work of the cultivation of clams the commissioners on inland fisheries and game or their deputies shall have the right to enter upon any of the clam flats in any town and to take therefrom young or undersized clams for the purpose of transplanting them to areas reserved for cultivation by the state.

SECTION 3. Digging clams on the areas thus selected and reserved by the state for cultivation is hereby prohibited for such time as the commissioners on inland fisheries and game deem necessary for the transplanted clams to attain mature growth, but not to exceed three years; any one digging clams on flats thus reserved shall be fined not less than twenty nor more than fifty dollars, or imprisonment not less than one month.

SECTION 4. At such time as the commissioners on island fisheries and game shall deem desirable the flats thus reserved for the cultivation of clams shall be opened to public digging, free to all; and notification of the time when this is to occur shall be posted on the shores near the flats, and published in the local press, if there is any, not less than one week before digging is permitted.

SECTION 5. When an area of flats whereon clams have been cultivated by the state is opened to the public, the commissioners on inland fisheries and game can proceed to reserve another area of flats for the cultivation of clams, as provided in sections one and two of this act.

SECTION 6. There shall be allowed and paid annually from the treasury of the Commonwealth a sum not exceeding twenty-five hundred dollars to carry out the provisions of this act.

SECTION 7. The executive officers of any town or city within which the cultivation of clams is undertaken by the state shall appoint a warden, whose duty it will be to prevent trespass upon areas of flats reserved by the state.

SECTION 8. All acts or parts of acts inconsistent herewith are hereby repealed.

There seemed to be general opposition to any measure looking to the acquirement of private control of clam flats, due to the feeling that all citizens have constitutional rights, so far as clam digging is concerned, that should not be legislated away for the benefit of any private person or corporation.

The opposition to the bill above quoted came chiefly from the towns of Ipswich and Salisbury, and was doubtless due to some misapprehension of the purpose of the bill, and also to a fear that the clam areas in those towns might pass from the control of the town officials, and thus be opened to citizens of other towns, — at least the cultivated sections. Whether there was any proper ground for apprehension regarding the practical working of this bill will doubtless remain a matter of opinion, influenced, as it may be, by local or other interests. Suffice it to say that the bill was defeated before the committee, and failed, as the others did, to be favorably reported. At the same time it is worthy of mention that evidence presented to the committee, by one connected with experiments made by the United States Fish Commission at Duxbury, was to the effect that clams which were transplanted there, and of which a careful record was kept, increased in size (and consequent value) fully 1,700 per cent. in fifteen months. Whether, in view of this statement and more or less corroborative testimony in the published accounts of these or other experiments, sufficient reason is found for the passage of some act which will authorize the State or others to engage in clam culture, remains to be seen.

In the mean time, it is interesting to note that Mr. Fitz J. Babson of Gloucester has started a "clam farm" of his own; and the result of his experiment, which already seems assured, may lead others to adopt similar methods.

The Gloucester "Times," after referring to the experiments conducted by the United States Fish Commission, says: —

> Now this is practically what Mr. Babson is doing on his farm. The only difference is, that he did not take nature's own flats for the purpose, but went to work and made flats of his own. All natural clam flats are public property by law, and clam farming has in the past been unpractical, because a man would not care to go to the work of seeding a portion of the common flats, and then, after he has done all the work, have somebody come along and scoop the clams and the profits, which the latter would have a right to do, being on the public flats.
>
> After getting the top surface off the farm, Mr. Babson went to work and dug rows about a foot deep in the muck. Into these rows he put small seed clams, as big as a quarter, and then covered them with muck raked out.
>
> That was two years ago. This year the promoters of the scheme have been down and dug some clams, and the increase in size is said to have been remarkable. The clam is a very rapidly growing shellfish, and this experiment of Mr. Babson's has proved it.

They will not be dug to any extent this season, as Mr. Babson has decided to let them remain three years before making a complete examination of the bed. There is no doubt that the experiment will be a splendid success, and the original idea of making a clam bed for farming purposes, which the promoter can protect by law, where he couldn't the clam flats, promises to open up a business which will give to future generations a good business, with large returns.

It is altogether probable that the artificial beds made by Mr. Babson will prove less prolific than natural flats that uncover only at low tide, and which are submerged, with the exception of an hour or so at low ebb, thus supplying superior opportunities for clams to feed. But he may, nevertheless, find cultivation of private beds more advantageous than depending on more favorably located public areas, for the simple reason that many of the latter have been "dug out" to such an extent that they are practically barren, while still possessing great potentiality of bearing if properly "seeded down" and protected for a year or so.

Whether we have reached the condition when it is necessary to undertake, officially or otherwise, the improvement of clam-bearing areas, is a question which should receive the earnest consideration of those most concerned. But when it is difficult or impracticable to secure for food any but small and comparatively worthless clams, the average citizen has an interest in this matter scarcely second to the fisherman; and undoubtedly it will be to the advantage of both if means can be taken to bring about better conditions.

Sea Fisheries. — A notable feature of the sea fisheries is the unusually small loss of life and property. Having in mind the terrible fatalities of other years, when it was not uncommon for several fishing vessels to founder in a single gale, going down with all hands, — often fifty to one hundred men, — the greater exemption from such disasters at this time is of inestimable advantage to the fisheries. It is true twelve fishing vessels have been lost during the year, but only one of these was lost at sea with all hands; she was a schooner of the old-fashioned shallow type, now recognized as unsafe. The other vessels were stranded chiefly, but one was burned in harbor and one was run down by a steamer and sunk, one of the crew being lost as a result of the collision. Only thirty-nine men were lost in the fisheries from Massachusetts, so far as the returns show.[*] Fourteen of these were lost in one vessel; of the others, some were washed overboard (one jumped overboard to save his son, and was drowned) and some were lost in dories, though the fatalities from the latter cause were perhaps never so few. On the whole, it has been demonstrated that the new class of vessels are as safe as it seems possible to make them, and that greater care is being taken to secure the safety of men going out in dories.

The success of the sea fisheries which will be considered here was not quite so pronounced as last year so far as quantity of products is concerned, although it was superior to anything attained for a number of years prior to 1900. It is possible here to make only the briefest reference to some of the more important features, although the importance of the industries coming under this head might justify more extended mention.

The mackerel fishery has on the whole been less favorable than it was last year, but the falling off in the total catch has not been large, and probably may be accounted for by the prevalence of unfavorable weather during a portion at least of the season. The reported catch of the New England fleet, composed for the most part of Massachusetts vessels, was 68,479 barrels of salt and 65,579 barrels of fresh mackerel; this gives us a total of 134,058 barrels. But these figures embrace only the fresh fish received at Boston. Conservative estimates place the fresh mackerel marketed at New York and other ports (that did not ultimately come to Boston) as fully 25 per cent. of the fresh fish landed. The total catch of fresh mackerel, according to this estimate, was 81,974 barrels, making an aggregate yield for this fishery of 150,453 barrels of salt and fresh fish.

The marked feature of this season's mackerel fishery is the growing tendency to market the catch fresh. According to the reports available, the salt mackerel catch of 1900 exceeded that of this year by upwards of 19,000 barrels, while the fresh mackerel received at Boston this season was more than 10,000 barrels greater than last year.

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[*] This enumeration does not include fishermen who died from disease, or a shore fisherman who was found drowned in a dock at Plymouth; but it does include some who were killed by mishap, like falling from aloft.

The season's fishing, notwithstanding rough weather, opened auspiciously. Good catches were made by both seiners and draggers * on the southern mackerel grounds, and were landed for the most part in New York. The fish were mostly of extraordinary size, and the outlook for a prosperous season was encouraging. Later, success was interrupted by fogs, and after the mackerel advanced farther north in their migrations, they seemed to scatter somewhat, and it was difficult to "keep run" of them, although good fares were obtained from time to time throughout the season by the lucky ones of the fleet, and not a few made large stocks.

Captain Jacobs, of the auxiliary schooner "Helen Miller Gould," is credited with landing the first mackerel of the year at Norfolk, Va.; and a few days later, on April 11, another Gloucester schooner, the "Monarch," marketed the first fare of the season at New York.

The following will indicate the success of the southern fishery: On April 25 the schooner "Helen Miller Gould" arrived in New York with a fare of 550 barrels of fresh mackerel, which was considered a "record breaker." On May 10 it was reported that about 100 fares were landed at New York from netters and seiners. The fish were so large and in such fine condition that they sold at good prices, despite the large receipts. The "Helen Miller Gould" sailed from Gloucester on her first mackerel trip on March 24, and was destroyed by fire at Sidney, C. B., October 25. She earned in that time a gross stock of $28,500. When it is stated, on the authority of Captain Jacobs, that within the period above mentioned the vessel was "tied seventy-two days at the wharf during good mackerel times, having the engine repaired," the magnitude of her earnings will be more impressive.

The schooner "Richard Wainwright," of Gloucester, landed a fare of mackerel in September that sold for $6,264.70. The "Wainwright" stocked $26,000 for the season; the "Margaret Haskins," $22,000; "Henry M. Stanley," $19,000; "Mary A. Harty" (auxiliary), $18,600; "Grayling," $16,300; and

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* Vessels fishing with long strings of gill nets, which are set at night. A long net warp or "swing" holds a vessel to the lee end of the nets, which are kept straight in the water by the schooner drifting or dragging them; hence the name. This method is called drift-net fishing in Europe, but has always been termed dragging in New England.

"O. W. Holmes," $15,500. All of these six vessels sailed from one firm, and their earnings have never been excelled in the mackerel fishery by a similar number of vessels of one ownership, except last year, when four of the same schooners stocked an aggregate of about $100,000. The mackerel season covers about seven months, and consequently the stocks given above do not represent a full year's work for any of the vessels.

There is a general impression that the bank cod fishery has not been successful. This may be true, as compared with some other seasons, if the aggregate catch is alone considered. But it is worthy of note that certain Gloucester vessels have brought remarkable fares from the banks, so that, with the prevailing high prices, they have made extraordinary stocks. Reference can be made, however, to only a few of these, sufficient, it is believed, to show that any apparent falling off in our salt fish product is due chiefly if not wholly to the growing tendency to market the catch fresh rather than to salt it, as in former years.

As early as June 4 it was reported that the schooner "Elector," of Gloucester, had arrived from the banks with a fare of 300,700 pounds of salt fish, which sold for $10,079.82. This was one of the largest stocks ever made from one fare in the salt cod fishery, and had never previously been equalled from a bank trip in May. The "Elector" was successful on her second trip, so that she made a total stock of $19,862 for the season's bank fishing. This is rarely equalled. The schooner "Columbia" stocked $14,500 in the cod fishery. The schooner "Independence" arrived home from her maiden trip on September 22, with a fare reported to be 375,000 pounds, — the largest catch of the season to that date. In August the schooner "Dora A. Lawson" landed a fare of 254,000 pounds of salt codfish, and stocked $7,778.96. About the same time the schooner "Ella M. Goodwin" landed 300,000 pounds of bank cod. In the latter part of August the schooner "Joseph Rowe" arrived home with 270,000 pounds of salt fish, and stocked $8,612.

Fine fares were also received from some of the banks nearer home, but in some cases at least the fish were fresh when landed. The schooner "Gossip" landed, on September 21, 200,000 pounds of fresh codfish, reputed to be the largest fare of exclusively fresh codfish ever brought in. Schooner "Belle Franklin," which arrived at Gloucester early in June, from a trip to Nantucket shoals, stocked $2,260, her crew sharing $103.88 each. She was probably absent from port about two weeks.

The data at hand also indicate fair catches in the Georges bank cod fishery, and occasional good fares of halibut, but these cannot be mentioned in detail. Large fares of fresh halibut from the Atlantic banks are now rare, but the schooner "Anglo Saxon" landed 85,000 pounds at Gloucester on April 9. Schooner "Senator" stocked $7,900 as a result of two halibut trips "which consumed seven weeks."

Swordfish were scarce during the larger part of the summer, and the catch was small.

On the whole, the market fishery has been good, and some large stocks have been realized. Among these the following are a few selected at random: —

In exactly one year, Sept. 18, 1900, to Sept. 18, 1901, the schooner "Effie M. Morrisey" is credited with stocking $30,000, which gave her crew a share of $780 each. The schooner "Mary G. Powers," of Boston, is credited with having stocked $30,000 in round numbers during the year. The schooner "Benjamin F. Phillips," which was launched late in the spring, sailed on her first trip June 4, and on November 21 — a period of five months and sixteen days — she had earned a stock of $21,449.53. This is believed to be a record in the market fishery, and may be considered still more remarkable because ten days of this time were lost on account of the so-called "Fisherman's race," in which this vessel won the first prize. The schooner "Clara R. Harwood," of Rockport, had stocked about $27,000 up to the first of December, and was still at work. Her crew has shared $1,200 each. She is one of the smaller of the market schooners, — about 40 tons, — and has probably made the largest stock and share of any vessel of her size. The schooner "William A. Morse," of Provincetown, stocked $20,000.

The herring industry, particularly the pickled herring trade and the curing of smoked herring of the kind ordinarily designated as "bloaters," has been prosecuted more largely than common. A fleet of twenty-eight schooners* went to Newfoundland this fall for cargoes of salt herring, but the reports received show that most of these fish will be salted in bulk, and that the question of careful cure will be practically ignored. The system by which quantity is considered preferable to quality, of which the consequent result is a catering to a cheap trade, seems to be still preferred, so far, at least, as can be determined from the data at hand.

Under existing conditions, with the American-cured herring valued far below what it should be, and with an evident difficulty to surmount in any effort to improve a long-established low reputation, it may be considered unprofitable by those engaged in the trade to make a determined attempt at change, especially with cargoes obtained late in the season on the north-west coast of Newfoundland, where it is considered an important question to secure a large cargo of fish as soon as possible and depart for home, quantity being deemed of more consequence than quality. Nevertheless, the matter of properly curing herring for our market is one of the most important questions that confronts the New England fish trade to-day; and it is to be hoped that well-directed effort will be made to insure the best cure and consequent high prices. It is certainly remarkable that our fishermen, who are noted for the care they give to the cure of mackerel, — to which alone their success in the mackerel fishery is due, — should be indifferent to the cure of herring, especially when, by the intelligent co-operation of fishermen and dealers, the field for improvement and consequent profit seems superior to any now available in the North Atlantic fisheries.

An instance illustrating present conditions is found in the fact that, about mid-summer, one of the schooners of the mackerel fleet made a large catch of fat summer herring on the off-shore fishing grounds. These fish — 200 or 300 barrels — were salted in bulk on deck, *without being dressed or cleaned in any manner.* When the vessel arrived the herring were sold for $2 per barrel, according to the Boston Fish Bureau report, when, if properly cured, they should have readily commanded a price of $9 to $11. That this is true is evidenced by the fact, patent to all who care to ascertain the truth, that herring imported from Europe sell at prices by wholesale ranging from $9 to upwards of $14.[*]

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* Six of these vessels — five from Bay of Islands and one from Bonne Bay — were reported on their way home November 16, with 8,000 barrels of salt herring, in bulk.

The importance of the demand for herring in the United States has been forcibly pointed out by Mr. Alexander T. Duthie who recently visited this country under the auspices of the Department of Agriculture and Technical Instruction for Ireland, as the fish trade expert of the Congested Districts Board, Dublin. His report shows that about 35,000 barrels of Scotch and Irish herring are annually imported at New York, and that between 30,000 and 40,000 barrels are received at Chicago, practically all of the latter from Holland and Norway.

But it is not only the growing demand for superior salt herring, which has carried New York importations of such fish from 500 barrels fifteen years ago to 35,000 barrels to-day, but it is the price paid for these herring that demands special attention. "While the price paid in New York last year for prime Scotch herrings," remarks Duthie, "ranged from $9 to $12 per barrel, the Donegal herrings were sold at prices from $11.50 to $13.50 per barrel." He also invites attention to the fact that "during the past season about 2,000 barrels of Newfoundland herrings, cured in the Scotch style, . . . were sold at from $8 to $9 per barrel."

The demand for herring in the west and north-west comes chiefly from natives of northern Europe or their descendants; but in New York the salt herring is in great favor among the Jews, who are believed to number fully half a million. "They are great consumers of herrings," says Duthie, "and frequently use them at every meal, when they can be procured. They are expert judges of both the quality and cure of herrings, and buy the best that can be got, for which they always have to pay the highest prices."

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[*] The following, from the "Fishing Gazette" (New York) of Nov. 16, 1901, is interesting in this connection: "We note the arrival this week of a small lot of new fat Norway herring to a west side up-town importer. They are KK size wholly, and are held at $12 or less, but another importer, who has also had some come in, is quoting from $12 to $14 on KKK and KKKK sizes alike. . . . A down-town importer this week received 75 barrels Newfoundland Scotch-cured herring by the 'Silvia,' and we are informed that more are to follow in regular shipments. At this writing (Friday) they had not been opened, but our information is that if they turn out well the price will be fixed at about $10 per barrel." In its issue of Nov. 23, 1901, the "Gazette" says:

Last winter choice, large, fat Irish herring, counting from 450 to 500 [to a barrel], sold at $14 to $15.50 per barrel."

Contrast this with the following item in the Gloucester "Times" of Dec. 9, 1900:

Newfoundland salt herring, $3 per barrel. Salt shore herring, $2.25 per barrel."

The following assertion of Mr. Duthie, like the foregoing quotations, deserves the serious consideration of all who are concerned in the herring trade in this State, or who are liable to be: "The very best herrings of the best cure and condition find the most ready sale in the American market, and it is useless for shippers to think they can export profitably to America any inferior fish, or any fish, however good, unless they are well cured and made to suit the taste of the purchasers, and carefully and attractively packed in the best barrels. . . . A great injury would be done to this new industry if roughly cured and badly packed herrings were sent from Ireland to America." He advises that "the herrings should be neatly gutted, carefully roused [stirred in pickle], and packed on their backs in the barrels. Just sufficient salt to cure the herrings should be used, and no salt should remain undissolved in the barrels after the herrings are cured. The 'filling up' of the barrels should be specially attended to. After sufficient time has been allowed for the fish to 'pine' in the salt, the barrels should be firmly filled, and great taste and skill shown in making a nice finish on the top rows of the herrings, so that when the barrels are opened the herrings will have an attractive appearance. These are the essential points to be attended to in curing for the American market."

These statements have been quoted not only because they contain information and suggestions which are important to those engaged in the ocean fisheries of this State, but also to emphasize the fact that careless and slovenly methods of cure, which may have sufficed at one time, are no longer adequate; and, unless we are content to resign to foreign competitors one of the most important fish markets on this continent, it is imperative that no time should be lost in adopting the best methods for curing herring, and rigidly adhering to them. We surely cannot hope to succeed in controlling our own market, when deep-sea summer herring, which are equal to the best the world has, sell for the insignificant price of $2 per barrel, simply because they have not been properly cared for. Nor could we long control our market for salt mackerel, if the fish were salted in a great mass in bulk, without being cleaned or cared for in any way. Any New England fisherman knows that mackerel thus treated would be unsalable at any price; and the wonder is that, knowing this, he should consider herring really fit for market which have been uncared for except that they have had some salt thrown on them. The whole matter can be summarized in a few words: Is it worth while to make the herring as valuable as the mackerel, or nearly so, by adopting a proper cure, and thus controlling the already large and growing market in this country? Or will it be wiser to persist in using antiquated and unsatisfactory methods, with no thought beyond the present, and no ambition to improve the opportunity that is presented, and let our markets be filled with foreign products, and thus be pre-empted, to the detriment of American fisheries? It may at least be hoped that the intelligence and business enterprise, which have done so much in the past to develop the ocean fisheries of Massachusetts, will find a way to meet present requirements in the herring trade, even though it is never an easy task to break up the habits of years and institute new ideas and methods.

The effort made by this commission to promote the trade in cod roe between the fish merchants of this state and France has met with considerable encouragement. The shipments and sales have increased, much information as to the best methods of cure, packing, shipments, etc., has been disseminated, interest in the business has advanced materially with the acquirement of knowledge by those interested, and the present outlook for the development of the exportation trade in cod roe seems promising. In this, as in the herring fishery, the all-important thing is that the roe shall be properly cured and the barrels well filled before shipment. Until now little heed has been paid to these matters, with the consequence that the demand for American cod roe, never large at any time, practically ceased, despite the fact that the Norwegians have had a trade in this article alone exceeding half a million dollars annually. When it is understood that the roe which may be saved for this trade by Massachusetts' fishermen is ordinarily a waste product, that is usually thrown into the sea, the importance of creating a market for it may be better appreciated.

At the suggestion of the chairman of this commission, Mr.

Thorndike Nourse, formerly of this State, but resident in France for several years past, has taken an active interest in promoting a French demand for American cod roe. Not only has he visited the regions where the roe is used for bait in the sardine fishery, and personally conferred with those controlling that industry or those who deal in roe, but he has published in "The Gloucester Times" an interesting history of the development of the use of roe in the sardine fishery, and the trade in it. Since then much has been done to promote the exportation of American roe, and there is reason to hope that the coming year may see satisfactory progress in the development of this branch of trade, and that it may ultimately attain to considerable importance.

The success of the new auxiliary schooner "Helen Miller Gould" last year led to the building of several others which were fitted with naphtha or gasoline engines. Among these were the "Mary E. Harty," 122.15 tons gross and 77.48 tons net; the "Victor," 121.68 tons gross and 75.92 tons net; and the "Dorcas," of about 60 tons. All of these belong in Gloucester. Several auxiliary schooners, which are to be fitted with naphtha engines, are now building for next year's mackerel fishing.

It may be mentioned that several smaller vessels, averaging 15 to 20 tons each, had been previously built and fitted with naphtha engines. They are the "Quartette" of Lynn, the "Empress" of Salem and the "Lydia" of Beverly.* These have been successfully employed in the fall herring fishery. In the prosecution of this fishery by the "Quartette" the use of an electric light for attracting herring at night was introduced, and is reputed to have proved very satisfactory, more so than the old method of "torching" the fish with a fire at the bow.

The advantage of having some motive power other than sails for certain kinds of fishing is gradually being recognized, and, despite the conservatism resulting from invested interests, there is abundant reason for believing that the time is not far distant when a marked innovation may take place in vessels employed in the market and mackerel fisheries. There is naturally a shrinking from incurring the cost of building steam vessels, and the added expense for running them, and it follows that, for the present, only the most adventurous will attempt to use anything but sails. It is also to be expected that first attempts at securing auxiliary motive power will aim to get something like naphtha engines, for instance, which will occupy the minimum of space, while comparatively little room will be required for fuel. But all this is more or less evolutionary, so far as large sea-going vessels are concerned; and while naphtha may prove useful on a small craft, there is apparently too much danger in using it on larger vessels to insure its general introduction. The destruction by fire, on October 25, of the auxiliary schooner "Helen Miller Gould," which resulted from ignition due to naphtha engines, proved how dangerous naphtha might be to life, if a vessel caught fire at sea, instead of in a safe harbor, as the "Gould" did.

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* We are indebted to the Boston Fish Bureau for the names and hailing ports of the last three vessels named, and also for the name and tonnage of the "Dorcas." Hon. William H. Jordan, collector of customs at Gloucester, has supplied the information about the other two vessels.

Under all the circumstances, it is not surprising that her owner, Capt. Solomon Jacobs, is having a steamer built. This will be a wooden vessel, 141 feet 7 inches long over all, 24 feet beam and 12 feet depth of hold on main deck. She is 14 feet deep on quarter deck. She will have from 300 to 450 indicated horse-power and single screw, with estimated speed of 10 to 11 knots under natural draught.

The main engines, which are light and compact, are of the vertical, inverted compound type. The high-pressure cylinder is 12 inches, low-pressure cylinder 28 inches, and stroke of both 18 inches; cranks set at 90 degrees, and main valves of the piston type. The surface condenser has 600 square feet of cooling surface. The feed pump, air and circulating pump, and bilge pump are all independent. She will be fitted with two water-tube boilers, with working pressure of 150 pounds per square inch. The single smoke stack, 25 feet high, will be hinged at the deck so that it can be lowered when cruising under sail alone. She will have a four-bladed propeller.

The fish room or hold, between the forecastle bulkhead and the machine or boiler room bulkhead, will be 50 feet long; this will be fitted with pens or bins in the most approved manner for the storage of ice and fish. She will have capacity for 40 tons of ice. She is also fitted with tanks that will carry 3,500 gallons of fresh water.

The striking feature of this steamer is its large area of unobstructed deck room, which is so highly important on a vessel engaged in the mackerel fishery.

"It is believed by many," says the Boston "Herald," "that the appearance of this vessel marks an era in the fishing industry, almost the last one in which the sailing vessel has held her own." That this belief is justified, one who has watched the progress in this direction elsewhere can scarcely doubt. There is strong probability that steam will eventually win its way in certain of our ocean fisheries.

In view, however, of the space necessary for coal, not to speak of its cost, the production of some safe, compact and less expensive motive power than steam is a matter of much consequence to our deep-sea fisheries.

The fact that a fishing steamer, intended for halibut fishery on the north-west coast, is building in San Francisco for Boston owners, is a matter of considerable interest. This is a first-class sea-going vessel, upward of 140 feet long.

A change in the method of packing fresh fish on the market schooners, heretofore recommended by this commission, has been adopted on some of the new vessels, and the material improvement in the appearance of the fish when landed will doubtless lead to the general use of sliding or adjustable shelves in pens on all vessels bringing fresh sea fish to our markets. Capt. Maurice Powers, of the schooner "B. F. Phillips," who made the remarkable stock already alluded to, told the writer that he had the shelves fitted to the pens when his vessel was new. Although their adoption necessitated the use of a slightly increased amount of ice, the fish came out in such superior condition that the additional expense was more than counterbalanced.

The following statements, which are extracted from a recently published report on "The International Fisheries Exhibition of 1898 at Bergen, Norway," were written by the chairman of this commission, and contain information that may be of practical use to the fishermen of this State; hence their publication here: —

Observations on Fisheries and Fish Markets. — The following notes on British fisheries and the methods of marketing fish are based upon studies and observations made in Scotland and England. They are far from exhaustive. It is not intended to make them so, but simply to invite attention to some salient features, the discussion of which at this time may prove helpful, in a suggestive way, to those interested in supplying our markets with fresh fish.

Aside from herring, nearly all the sea fish taken by British fishermen are marketed fresh, and whatever tends to improve the quality of the product and to make the supply nearly uniform at all times leads to greater appreciation of and reliance upon this kind of food and enhances the demand for it. It is scarcely necessary to add that success in commercial fishing depends on the creation of a demand for the products, the practical certainty of meeting with quick sales and getting remunerative prices. Whatever brings this develops prosperity, and the latter commands the services of the most skilful, courageous and enterprising men. It is my purpose briefly to point out a few things which seem to have brought about an unexampled period of prosperity in the British fisheries.

Existing conditions are doubtless due largely, if not exclusively, to improvements in putting fresh fish upon the market. While in Great Britain I had a purpose in eating fish, generally to test their quality. I ate them at hotels, in plain eating houses, at restaurants, at boarding houses and in private families, and invariably found them in the best condition, with their natural flavors well preserved. I visited the fish markets at the fishing towns and in London, and noted the condition in which the fish are marketed by the wholesale trade, and the retail markets of the metropolis were also subjects of observation. In all cases the result was satisfactory, and the condition of the products, as sent to the retailer or delivered to the consumer, suggested the reason why the demand for fish exists; for it is evident that the sale of fish in the best possible condition creates a market for more, while every fish sold which gives dissatisfaction to the consumer decreases the demand for such food. This being conceded, the next thing to consider is the question of how present conditions in the British fish trade have been brought about.

Unquestionably the adoption of steam fishing vessels has been the prime factor that has made present conditions possible. It is true much was done by steam carriers to improve conditions before the advent of steam trawlers and steam liners. But, while the former are still performing a valuable service in attending upon the fleets of sailing smacks and daily bringing their catch to market, the frequent independent trips of the steam liner and steam trawler have revolutionized the trade, and made possible what was before impracticable.

A rivalry also seems to exist between fishing ports regarding the quality of fish put upon the market, and this tends to good results, for the recognition of the fact that the trade of a place depends upon the reputation established for its goods impels all to use the utmost care and good judgment.

Of course when steamers — either trawlers or liners — make trips to distant fishing grounds, like those lying off the west coast of Norway, the Faroes and Iceland, the fish must of necessity be on board several days before they are landed; and the fish caught are not in such fine condition as when they can be marketed within a day or so from the time when they are caught, as is most commonly the case. It is, however, to be said that many, if not most, of the line steamers which make these distant cruises have wells in which the fish first taken can be kept alive. The last of the catch can then be iced, and will thus be comparatively new and in good condition when the vessel arrives, for the passage is seldom longer than three days. The trawled fish caught at the same time and place must of necessity be in a less desirable condition, for all are iced. Nevertheless, it is fair to state that vessels resorting to these distant grounds usually fish a very short time, consequently it rarely happens that their fares are in bad order when discharged. It is also true that the great bulk of the catch is taken comparatively near home, and the fish are marketed in the best possible manner.

Methods of Trawling, etc. — In recent years the beam trawl has been entirely superseded by the otter trawl on steamers. The otter trawl covers more ground, fishes better than the beam trawl, and is easy to handle. The ordinary width of the mouth is 64 feet, which is 10 feet wider than the largest beam trawl. The otters are 8 feet long and 3 feet 6 inches to 4 feet high. There is little change in the construction of the trawl net, except in the size. The wings, belly, square, etc., are longer, but the "cod-end" is the same as in the beam trawl. The otter trawl is well adapted to the capture of haddock and other free-swimming species, which make up the bulk of a trawler's catch.

When fishing, a trawl is ordinarily towed about three hours; but, while this is perhaps the time most commonly adopted, there is considerable variation, due to the character of the ground, the known or supposed plentifulness of fish, etc. If a good catch is made, the trawl on the opposite side of the steamer is shot as soon as one is up, and it is towed over the same ground, unless the strength and trend of the current prevents. If, however, the result is unsatisfactory, the vessel generally steams away to a new position.

Trawled fish are usually gutted, and packed in ice on shelves in the pens of the fish room. They are put in boxes for landing. If conditions permit, the fish are boxed between five and eight o'clock on the morning of the arrival, and put on the pier or " pontoon " for sale. With few exceptions, fish from trawlers are sold in boxes at Grimsby; but the line-caught fish, such as cod, halibut, etc., are laid out in rows, according to sizes and condition, and sold by the score, if there is a considerable quantity in a lot, otherwise, they are disposed of by the piece, pair or lot. The sales begin at eight o'clock A. M., and continue until all fish are disposed of. Everything is sold by auction. While the sales are still going on the fish sold are rapidly packed into boxes, barrels or other receptacles, and are promptly dispatched on swift trains to their destinations in various parts of the country.

Long-line Fishing.—The steam long-line fishery, however, seems to demand more attention here than trawling, for the reason that there is small probability of the latter immediately becoming a prominent feature of our fisheries, while the long-line or trawl-line fishery is already well established in the United States, although it is prosecuted from sailing vessels and by an entirely different method from that in vogue in Great Britain.

The steam liner "Phalarope," one of the fleet of Mr. T. F. Robertson Carr of Aberdeen, may be taken as a fair example of the first-class long-line steamers fishing from that port, although she is not so large and expensive as many of the liners from Grimsby, some of which are 120 feet long or more between perpendiculars, or about 130 feet over all. The "Phalarope" is 103 feet long. However, her equipment, the arrangement for the care of fish and the methods of fishing prosecuted on her may be taken as typical, though of course there may be some local differences of outfit, and the exigencies of fishing, or individual opinions of different skippers, may cause some variation at times in fishing.

Fishing Gear.—The lines used by the "Phalarope" are rigged for the capture of halibut, cod, ling and various other species of ground fish which can be taken with hooks. The ground lines are hemp. They weigh 3½ pounds to the "cut" of 60 fathoms; the gangings or snoods weigh 1¼ pounds to the "cut." No. 12 Kirby-bend hooks are used. The gangings are 2 fathoms long, and approximately 4 fathoms apart on the ground line. The lines are rigged in "strings" of 60 fathoms each, and 8 of these, with a total of 130 hooks, constitute a "basket" of line. The lines are coiled in large willow baskets, which have cork around one side of the rim for the hooks to stick into. The "Phalarope" carries 40 of these baskets of line, with 5,200 hooks, and an aggregate length of 20,200 fathoms, or considerably more than 20 miles of line. The buoy lines do not differ materially from those of the New England fishermen. Hard-wood conical buoys are used. These have a long wooden staff going vertically through the middle, and usually fitted to receive a lantern at the top.

The "hook iron" used for disgorging hooks from fish, or killing them, is made of three-quarter-inch iron, 13 to 16 inches long, with a knob at one end, and with the opposite end flattened and split so as to fit over the bend of a hook.

For a part of each year herring nets are carried for catching bait. The season during which bait is taken by the line steamers is usually from March 10 to September 15. Sometimes herring nets are carried later in the season, and occasionally even to November, if the steamers are fishing on southern grounds, where herring are often found late in the year. In winter squid and herring are purchased for bait.

A line steamer will carry about twenty-five herring nets in summer. In Scotland sheepskin buoys are used for these, since they are very durable and tight, as well as cheap. They cost only about 60 cents each, and last from three to four years. A yellow sheepskin net-float looks like a pumpkin. It is 12 to 15 inches in diameter; is first tanned and then tarred on the inside; the outside is usually coated with ocher. It has a wooden stock or staff in it, around the neck of which the skin is gathered and lashed so as to exclude water. There is a hole in the end of the staff for the buoy line to fasten into.

The stout warp which holds the nets to the vessel, when they are set, has a section of chain next the nets. This warp is called a "bush-rope" in Scotland.

Methods of Fishing. — The method of fishing is as follows: The lines are shot from the vessel and hauled on board of her. Boats are never used for setting or hauling the lines. It is very severe weather when a steamer fails to set or haul her gear. Often the lines are shot, says Captain Forbes of the "Phalarope," when everything is afloat aft, where the men must stand to put them out. It is not uncommon for the deck to be full of water and baskets of trawl-line floating about, and it is often difficult in "coarse weather" for the men to keep their feet as the vessel rolls rails under or the short combing seas tumble on board.

When the lines are being shot, the vessel is kept at a speed of about 6½ knots and headed across the current, if the conditions are at all favorable for such a course. In some instances, however, when it is desirable to keep on a small patch of ground, the course may be changed, and less attention is given to the set of the tide. The object in placing the lines at right angles to the current is so that the snoods to which the hooks are bent will lay out clear of the ground line.

The lines are baited as they are set; three men are usually engaged in baiting the hooks, and one man "runs them out." A whole herring is put on each hook, particularly when fishing on soft bottom, and always when there is sufficient bait. Occasionally, when bait is scarce and the gear is put out on comparatively hard bottom, the herring are cut in two and a section is put on each hook. A whole herring is preferred for bait, especially on soft bottom, because of the abundance of the slime eel (*Mixine glutinosa*), which would soon strip the hooks if the herring was cut, and leave small chance for the capture of cod, halibut or other useful species. In baiting, the hook is passed through one eye of the herring and out through the back.

To shoot a long line, the buoy is first thrown over and the buoy line run out; then comes the anchor, to which the last end of the buoy line and the first end of the ground line are bent. The hooks are then baited and "run out," as already stated. Before one basket of line is out, an end of the second basket is bent on, and thus the work proceeds until the whole string of gear is in the water, when the last anchor, buoy line and buoy follow, and the ground line with its many baited hooks sinks to the bottom. No buoys or anchors are used beside those at the ends, except when a shot is made just before the steamer is going to market, and when it is important to have the line sink to the bottom as soon as practicable, so that it may have more time to fish. Then a piece of metal, usually weighing 5 to 10 pounds, is bent to the ground line about three baskets from the last end thrown out. After the line is out the steamer lies by the last buoy, keeping close to it, so that it may not be lost sight of. There is a lantern on the top of the staff, which enables the fishermen to keep track of the buoy during the night, and strict orders are given those on watch to keep the vessel in position. Indeed, this lying by the "dan," as the buoy is called, is a matter of the greatest importance to all, for the success of the trip, as well as the value of the gear, depends upon always being within sight of the light on the buoy staff. It is customary to lie by for about three hours. During this time a vessel usually steams against the current from one-half mile to two miles, according to the condition of the weather, when she stops and drifts back until she approaches close to the "dan," or passes by it, when she again heads the tide and gets into position. This is repeated until the time arrives to begin hauling the gear.

In the mean time, those not on watch are sleeping. It is important to utilize every available minute for rest, for the men are compelled when at sea to be actively engaged in arduous work, even when the conditions are very severe, during the greater part of the twenty-four hours.

The best time of the day for setting long lines for cod varies with the seasons. In autumn more fish can be caught if the lines are shot in the evening, while in spring better results are obtained by putting them out late in the night or in the early morning. The lines are hauled by night as well as by day, and under nearly all conditions of weather. In the fall and all through the winter fishing is prosecuted only at night, for day fishing would be unprofitable. Therefore, as stated, the lines are shot in the evening, and hauling begins some three hours later. In spring and summer day fishing is most successful.

The entire complement of gear is rarely set in winter. The quantity used depends largely on the condition of the weather, but it is seldom that more than 25 or 30 baskets of line are shot at a time, since at that season it is deemed preferable to use a moderate quantity of gear and thus have a better chance of getting early to market; for in winter a steamer may market her catch three times a week, and exceptionally four times, while in summer, when she is fishing on more distant grounds, she may be able to make only one trip a week.

In summer halibut constitute the most important part of the catch of steam liners from Aberdeen, but in winter skates are in demand and have been sold at good prices. Occasionally large financial results have been obtained by a vessel making exceptionally good catches of skates.

Care of the Fish. — Ice is used both in winter and summer for packing the fish on board the steamers, and this is invariably ground fine before being taken on board, — a custom practised in all parts of Great Britain where block ice is not carried on the vessels. About two tons of ice is usually sufficient for a winter trip; but the Aberdeen liners carry double that quantity in summer, and the vessels going on longer trips to distant grounds take a relatively larger amount of ice. The ice is stowed in a section of the vessel's hold devoted specially to that purpose, and called an " ice pound." This is usually forward of the fish room. A door leads from the ice room to the fish room, for the convenience of the men in getting the ice, which, being all ready, can be promptly used. The fish room is subdivided into pens or bins, like the ice house of a New England market schooner, and these have sliding adjustable planks in front, so that they can be closed up gradually from below as they are filled with fish. They are also fitted with plank shelves or horizontal platforms, eight inches apart, upon which the fish are iced. Thus, after the bottom tier in the pen is stowed, a layer of fine ice is put on the shelf next above, and the fish are laid on the ice, with ice between them, but no ice is put on top of them, except when the vessel is far from market, and it is not customary to lay one tier of fish upon another. Every possible effort is made to prevent the fish from having any appearance of being jammed, consequently when landed they look as if they had just been taken from the water. The aim of the Aberdeen fishermen has been to put their catch on the market in the best possible condition, and within as short a time as practicable after they are caught.

Marketing the Catch. — In winter the lines are usually hauled about three o'clock in the morning, and by ten or twelve o'clock of the same day the steamer is in port and the catch is landed. In summer, when the vessels are working on more distant grounds, usually off the coast of Norway, it takes a longer time to reach the home market; but even then it is seldom that fish are more than twenty-four to thirty-six hours old when they are landed.

The fish are sold at Aberdeen, or elsewhere in Great Britain, at auction. Each vessel owner usually has a fish salesman to attend to the disposition of the catch of his steamers. There are also a number of men who assist in landing the catch and arranging the fish for sale, by placing them on the market dock in tiers or rows, according to grade, or in any other way required by the trade. As a rule, halibut are sold singly or by the pair; cod and ling are generally sold singly in summer, or by the score, half-score or quarter-score in winter; perhaps more are sold in lots of five than otherwise. The sale of skates varies with the supply and demand. One visiting the market can generally tell what the demand is, if he notes how skates are being sold, — whether by the score or smaller lots, — for when the price is high they usually sell by fives or tens.

The fish auction at Aberdeen (as indeed in most of the British markets) is interesting and instructive, but more or less puzzling to a stranger, for one unaccustomed to it is generally at a loss to know how the bid of a buyer is indicated, for it is rarely announced in words. But the alert and trained salesman is on the lookout for a wink or a nod, or other signs, which the initiated know pass for bids, while the novice is surprised to hear the call of bids by the auctioneer, when he is unable to determine what has been offered, or by whom, even though he watches closely. It seems to be part of the buyers' plans to conceal their identity with bids, so far as practicable; and I was told that a pull on the salesman's coat, or similar hidden signal, is often made to indicate a bid. It is all, however, intelligible to those accustomed to the trade, and the business is carried on very rapidly and much more systematically than one would expect who had never seen anything of the kind.

After the steamers reach market the gear is usually cleaned of old bait and made ready for use before they sail again. This process of preparing the apparatus is called "ridding" the lines.

Unless repairs are needed, a steam liner rarely fails to go to sea again as soon as possible after landing her catch; for, whatever the condition of the weather, rain or shine, blow high or low, she is off for the fishing grounds as soon as the fish are out, and coal, ice and necessary stores are on board. The storm that detains a fishing steamer in port must be exceptionally severe; for it is in bad weather, when sailing craft cannot go to sea, that the steam vessel reaps her richest harvest, since prices then are high. The fearless and hardy fishermen literally defy the elements in their sturdy steel and iron boats, and reck little of being half submerged much of the time. Thus, whatever the conditions, it is a warfare with nature, for it is "drive, drive, out and in." Captain Forbes told me that he had seen the high bow of the "Phalarope" go under a green sea when he was pushing her hard for market, and the water would go rushing like a cataract past the pilot house and out over the stern and rails. But there was never a thought of decreasing the speed, for "all is iron," and the contents of the fish room must be on the pontoon at Aberdeen next morning, whatever the risk or discomfort. The official zeal, courage and endurance of these sea toilers are only equalled by their supreme confidence in the vessels they sail on; and this confidence can scarcely be wondered at, for these fishing boats rarely meet with serious disaster at sea, and actually pursue their hazardous work when much larger vessels are lost at sea or on the coast, or are compelled to seek shelter in harbor.

Lay and Wages. — On the Aberdeen steam liners, settlements are made weekly with the crew. The method of payment is a mixed share and wage system. The engineer, fireman and cook are paid weekly wages and receive no share. The usual wages are £2 per week to the engineer, £1.6 to £1.10 to the fireman, and £1 to £1.5 to the cook. The cook, however, receives larger pay in summer, when nets are carried for catching bait. All others are on shares. The system of settlement is as follows: The harbor and dock dues, commission to salesman, coal, ice, stores and cook's wages are deducted from the gross stock. The net stock is then divided equally, one-half going to the vessel and the other to the fishermen, or those who receive no wages. The crew's half is equally divided among the men, the captain included, who receives no more than any other sharesman; sometimes, however, he receives a small bonus from the owners, particularly if he is a "lucky skipper," but this seldom exceeds £15, or about $75 per annum, and is usually about £5. Occasionally a master may be a share holder in a fishing steamer, but this is not common on the liners. From the vessel's half of the proceeds the engineer and fireman are paid; also a bonus of 1s. to the pound on the gross stock, if it exceeds £40 per week. This is called the "stoker." The balance is the steamer's earnings.

The above method of settlement is limited to the season when bait is caught at sea by a steamer's crew. When bait is purchased it is deducted from the gross stock, and at that season the engineer's and fireman's wages also are taken from the gross earnings. Thus, in winter, the sharesmen not only pay half the expense for bait, but also half of the wages for hired men.*

Pickle Pump. — Among the most useful devices exhibited by Russia was a hand pump, with hose, etc., attached, used for forcing pickle into barrels filled with fish. . . . It consists of an ordinary form of force pump, mounted on a wooden horse or stand. It has a wooden lever handle, and is provided with a corrugated rubber suction hose underneath, with a strainer at its lower end. It has a canvas discharge hose, fitted at the end with a metal spout for entering a hole in the head or side of a cask, and with a simple form of stop-cock to shut off the flow of brine when the barrel is full. Fish are packed dry, as in this country, and are pressed tightly into the casks; the barrels are then headed, and the pickle is subsequently pumped into them. This seems to be a decided improvement on the system of pickling fish in barrels in the United States, where as a rule, only a simple funnel is used, into which the brine is poured until a cask is supposed to be full. It is far within the possibilities that sufficient pickle is not always put on by the method referred to, and much of the loss of pickled fish, which is now no small factor in the American fish trade, doubtless might be prevented by the use of a pump for forcing brine into the barrels.† . . .

Game.

The Preservation of Game. — Those who have given much thought to the subject realize the great importance of protecting our game birds and certain game mammals, also the song and insectivorous birds which are found within the limits of this Commonwealth. If there were no other reason for the preservation of these than the fact that they are necessary as a means for the healthful recreation that is found in hunting, there would be ample justification for the utmost effort to continue certain species for the benefit of the present generation, and to take such measures as are necessary to transmit them in undiminished numbers to generations yet to come. It has been well said that "if those who are to follow us are to know and enjoy the game bird or wild songster of to-day, if the farmer is to have the help of all these in the destruction of injurious worms and insects, if the country is not to be transformed as far as possible into a desert, by taking away of these forms of beautiful color and sweet music, some positive position must be taken and maintained for their protection."*

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* Report of the United States Commissioner to the International Fisheries Exhibition of 1898 at Bergen, Norway, pp. 430–439. Washington, 1901.

† *Ibid.*, pp. 305, 306.

It is gratifying that the necessity for taking a "positive position" in the matter of game protection has been so fully recognized by the General Court of Massachusetts in recent years, even if it must be conceded that some of the wise laws which have been enacted may need supplementary action to make them as completely effective as was intended.

There is undoubtedly a very utilitarian side to the protection of game in this Commonwealth. With the passage of years the New England States have become increasingly the favorite resorts in summer and autumn of those of ample means, who find an abundance of game one of the greatest attractions which nature offers. It is well known to be an inducement to some, more powerful than any other; hence millions of dollars are annually spent by sportsmen in a neighboring State in the enjoyment of hunting, and no insignificant portion of those millions is contributed by citizens of this State. If, then, it is possible by judicious protection to improve our game conditions, so that sportsmen from less favored States and from this Commonwealth shall be attracted thereby, it is evident that positive benefit will result, inasmuch as considerable sums of money will be retained within our own borders which otherwise might go elsewhere. It certainly seems wise to utilize as fully as possible the large areas of wild land and covers that still remain in the State, and to that extent hold out an inducement for those with means to build summer homes in many localities which may be largely benefited thereby.

But there is another side to this question. While the well-to-do may experience no special deprivation from a scarcity of game in this State, because they have both time and money to seek desirable conditions in other localities, it must be conceded that a reasonable conservation of game by adequate protection, stocking the covers, etc., is a matter of much moment to thousands who may derive both pleasure and physical benefit from hunting, but may not be able to expend the time and money required for a trip to some other State or to Canada. It is therefore highly desirable that every reasonable effort should be made to preserve and increase the game in Massachusetts, and the benefit to be derived therefrom seems to warrant any reasonable outlay which may be made for such a purpose.

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* Circular of J. H. Worden of Pennsylvania.

Referring to these questions, the Boston "Globe" of Jan. 24, 1901, makes the following statements: "Generous encouragement from the Legislature in the way of a sufficient appropriation to conduct experiments and to keep in active service a corps of game wardens is all that is necessary to retain within the State boundaries a supply of game in abundance sufficient to warrant good shooting. There is no good reason why shot-gun men should be forced by scarcity of game to go to other States for their field sports. What the privilege of hunting means to men whose business confines them to workshops, manufactories and counting rooms cannot be expressed in words or figures. The desire to hunt is almost universal, and probably no other form of recreation is so healthful or so helpful to jaded nerves. Some have the time and means to visit other sections to enjoy the privilege of hunting, but a larger number cannot afford this, even though they may most need the relaxation from their ordinary duties which it brings. It is to the advantage of the general public, and consequently beneficial to the State, that every reasonable measure should be taken to promote an increase of game."

But, even if the claim made by some, that hunting is a "fad," be granted, and its great advantage as a recuperative recreation be ignored, there is still an imperative necessity that wise protective laws should be enacted, and that they should be enforced with vigor and determination. This may be more fully appreciated when it is known that science has declared that "this world of ours would not be inhabitable by men in fifty years after its bird life had been taken from it." It is only necessary to refer to statements made by E. H. Forbush, ornithologist of the State Board of Agriculture, to be able to comprehend this, and to realize the importance of the work that is continuously carried on by birds during certain months of the year. Few appreciate how much humanity is indebted to birds, but there can no longer be excuse for neglecting them.

Effect of Recent Laws. — The laws relating to shore, marsh and beach birds (Acts of 1901, chapter 178), to squirrels, hares or rabbits (Acts of 1901, chapter 102), to snaring partridges, hares and rabbits (Acts of 1901, chapter 141), and to shooting in Boston harbor (Acts of 1901, chapter 174), have all been so recently enacted that it is too soon to speak with precision and in detail of their effect. It can, however, be said in general terms that their effect has been very beneficial. The full protection to the passenger pigeon, the small gulls and the terns is most desirable, and may be expected to lead to gratifying results. The change in the opening of the hunting season for squirrels, hares and rabbits, so that it corresponds with the beginning of the open season for other game, is most commendable; while the same can be said of the change in the snaring law, whereby snaring on one's own land is legal only during the months of October and November.

But it is possible to judge with some accuracy of the effect of the game law which prohibits the sale of partridge and woodcock (Acts of 1900, chapter 379), for its beneficial results are already observable to a very pronounced degree in nearly all sections of the State, notwithstanding it has been in force so short a time. There can be no doubt that the increase in ruffed grouse, concerning which there is a large mass of evidence at hand, is directly attributable to this measure and the active enforcement of the game laws. The outlook for the woodcock also seems somewhat improved, even to the extent that it is reported breeding in this State, although it is well known that its appearance is generally as a migrant.

While the act referred to does not prevent the sale of quail from cold storage between the 1st of December and the 1st of May, if legally taken in this Commonwealth, the nearly practical elimination of the pot hunter, by the restrictions on the sale of partridge and woodcock, has unquestionably proved a protection to quail, and to that extent has led to their increase. It is the universal testimony that quail have not been so abundant in many years as during that covered by this report.

The following extracts from letters and reports of deputy commissioners and from the press will perhaps suffice to show the effect of the legislation referred to, even though the statements quoted are only a few of the many that are available: —

Deputy William N. Prentiss, writing from Milford, September 27, makes the following statements regarding game in that vicinity: "Quail are very plenty, in fact I never saw as many during the spring and summer; while at the present time there is a covey in every hedge-row, and in riding a distance of less than a mile from my house, yesterday, I flushed three [coveys] of from seven to a dozen. There are more partridge than last year, judging from what I have seen while in the woods at work, and looking for hunters. There is no doubt the shortened open season, with the markets closed to the hunters, has helped these birds more than anything which has been done for a long time. The woodcock here is only a traveler, there being scarcely any except flight birds. Gray squirrels are scarce, the large timber being nearly all cut off, although a few are to be found in some localities. Rabbits are plenty."

Deputy John F. Luman of Palmer, writing on October 1, makes the following statements relating to game, and success of hunters on the first day of the open season: "I write to inform you of the success of the first open day on game in this section, and also to let you know that some of the sportsmen have changed their minds considerably from last year when the law was made tight against the sale of birds. In the section of woods I covered to-day I met no less than seven hunters, and all reported excellent luck. I saw their game, and each had partridge, quail and gray squirrel. I had a few minutes' talk with each of them, and some of those I met one year ago were bitter against existing laws, and said many things about the commissioners and your humble servant. To-day they acknowledged that they were wrong in their opinion, and said that the commissioners were doing their duty nobly; they were well pleased with work already done, and hoped that the good work would continue. They all said that they had better luck than for five years past, and said that all kinds of game were plentiful this season. I was in Palmer to-night when two hunters returned, and each had his game bag filled with game. They said that this section was alive with birds this year, and both said it was due to the commissioners and their good work in looking after game. They predicted that if game was closely protected in the next two years, as in the past year, there would be an abundance of sport for all."

Referring to small game at Ludlow Centre, Mr. Luman made the following remarks in his report for the week ending June 23: "Mr. Gates says that game is very plentiful. Partridge, quail and rabbits are very numerous; quail run through his door-yard frequently."

Deputy A. D. Putnam of Spencer, writing on November 10, made the following statement: "I have been out hunting quite a number of times, and the smallest number of partridge I have flushed was seventeen, which was one afternoon. All the other days I have found from twenty to thirty, and it is a fact that we have more partridge in Worcester County than we had last year, regardless of what others may say. I have hunted partridge for twenty years in Worcester County, and I ought to know. In regard to quail, there never were so many in this county as there are to-day."

Deputy Otis Thayer, writing from Lenox, says: "As the season advances, I find a great many partridge, and many broods are reported. . . . The members of the club feel encouraged, and they say if things continue for a year or two there will be birds enough. The winters are too severe for quail here, and there are none."

Deputy Smith of Pittsfield reports, on October 6: "The season opens on birds very good. Some of the boys have made good bags. J. H. Wood and son caught twelve the first day. One party at New Ashford captured seventeen."

The North Adams "Transcript" of November 8 quotes a Pittsfield news item as saying: "The hunters report good luck on partridge this fall, and some of them have seen pheasants in the covers." The pheasants seen are reported to have been "promising, as they are full grown."

Deputy A. M. Nichols was in the south-western part of the State when the hunting season opened. He states: "The sportsmen throughout that section report lots of birds and squirrels." Writing on November 7, he made the following statements: "A Mr. Taylor, a business man of Springfield, went out to Greenwich yesterday, hunting, and returned to Springfield last night. I heard him tell Mr. Nelson that he kept count of the partridge that he scared up during the day, and that he flushed up 40 birds in all. Dr. Herrick also said that he never saw so many woodcock and quail as there are this fall." He also says: "Mr. Joseph Wood of Pittsfield states that he has had better bird shooting this fall than he has had in years. He also reports woodcock very plenty."

A Pittsfield dispatch in the Springfield "Republican" of November 13 says: "Joseph D. Shearer holds the local record for partridge and woodcock shooting this season having bagged twenty-five of the latter and fifty of the former birds to date."

The Worcester "Telegram" of October 23 has the following: "Hudson hunters say there is more game in this vicinity [Hudson] this year than there has been before for ten years."

Mr. Luman reported that all the hunters he saw at Wilbraham had met with good success, and said there was an abundance of game.

Deputy E. C. Hall of Ashville, writing under date of July 27, makes the following reference to the effect of the game law of 1900: "The law, stopping the selling of ruffed grouse, came just in time, and we will have a very good lot of birds this fall, and they will surely increase year by year, as nine-tenths of the birds [formerly] killed in this section were sold. That has been entirely stopped and birds will increase rapidly. In two years we will not have to go to the north woods to find good grouse and deer shooting."

On July 9, 1901, Deputy W. J. Cross of Becket wrote as follows: "Young partridge are scarce, but few being seen. Although there was a large stock wintered over, there was a great deal of rain when they were hatching, and I think they were killed off. Woodcock were very plenty in the spring, and nested here pretty freely."

Partridge appear to have been plentiful in the vicinity of Fitchburg and Leominster. The following item from the latter place, on October 16, was widely published: "Charles Marine was out hunting, and while driving along in his buggy two partridges flew up, and he blazed away, killing the two birds with the first shot. He drove along a little farther, and it seemed as if the birds came up just for the purpose of letting him try his skill, as he shot a third bird from his wagon seat."

The Taunton "Gazette" of October 25, 1901, says: "Local hunters are finding a lot of game this year in the vicinity of Taunton, — if they know where to go. . . . Another thing that is keeping game plentiful about here is the law against gunning for the market. . . . The only place where there is any abuse of this law to any extent is near the Rhode Island line, where market hunters get out and shoot, and sell their game in the other State."

Deputy George W. Goldsmith, writing from Beverly, on July 26, made the following statements regarding game birds in that locality: "Quail are doing finely in this vicinity. There are more birds this year than for five years back. I liberated two dozen in April, which are doing well. I have seen four or five flocks of little ones within three hundred yards of my cottage. . . . I notice in my neighborhood that the gunners respect the law very well."

Deputy Otis Foster, writing from Pembroke, under date of June 26, says: "Song birds and quail are very plenty, more so than for many years. There are three pairs of quails within fifty rods of my house. I see them almost every day. . . . There will be good fishing this fall."

Capt. W. C. Dunham, writing from Nantucket, on September 21, says: "Quail are quite plenty."

The following press items at the close of the hunting season are interesting, to the extent that they give the result of the fall shooting in the western and central sections of the State, and perhaps make it easier to fully comprehend the effect of the law: —

The Pittsfield "Eagle" of Nov. 29, 1901, says: "The close season on partridge and quail goes into effect Sunday. This season has been one of the best bird seasons in years, despite the fact that during the period of incubation the wet weather which prevailed doubtless prevented many of the eggs from hatching. Birds have been and are now very plenty, and the three years' prohibition from shooting for the markets has proved to be a most efficacious method to restock with birds the covers in this section of the State at least."

The Worcester "Telegram" of Dec. 1, 1901, has the following: "There isn't in evidence a sportsman in Worcester but who is heartily in favor of the shorter season clause of the law. Men who pursue the sport with dog and gun are practically unanimous in indorsement of the new law, which has now been in force two years. There are scores of shooters who believe that the effects of the curtailing of the season are already apparent in more partridges and in a greater abundance of quail. If there is any one who wants to return to the old system, under which birds were slaughtered from September 15 until January 1, he has not appeared in evidence, or has not the hardihood to express himself. The fact that there have been more birds this year than last, in spite of a marked increase in hunting, indicates that the law is already doing good work. Although the abundance of birds must to some extent be credited to an excellent breeding season, still, there is little doubt that the increased parent stock, the result of barring the slaughter of last December, was a very potent factor in increasing the supply. When two men can go only a few miles from Worcester, a city of one hundred and twenty-five thousand inhabitants, and bag twenty-seven birds in a day, no one can argue that game birds are on the ragged edge of extinction. Two of Worcester's fastest men killed eighteen quail and nine partridges in a single day last week. Four men a short time ago bagged thirty-two birds, eighteen partridges and fourteen quail, in a single day, and it is safe to assume the quartet started close to eighty birds during the day in the covers. Two Worcester men wound up the season Saturday by starting thirty birds, eighteen of which were killed. When these figures are quoted, it takes pretty strong arguments to convince good judges that game birds are disappearing from the map of Worcester county. . . . To be sure, the wise ones say, it is to be expected that birds will be cleaned from the covers on the very edge of the second largest city in Massachusetts. But the covers of Brookfield, Spencer, Sutton, Fiskdale, the Brookfields and Brimfield, and other surrounding towns, are doing business with the ruffed grouse in about the same old way. And an extension of the present law to cover another period of three years at its expiration next season, is believed by many to be all the protection needed to insure partridge shooting to children's children."

In his report for the week ending December 1 Deputy Luman says: "Saturday, the last day of the season, brought out a large number of hunters from Worcester and Springfield, and I saw some of them when they were returning. All reported

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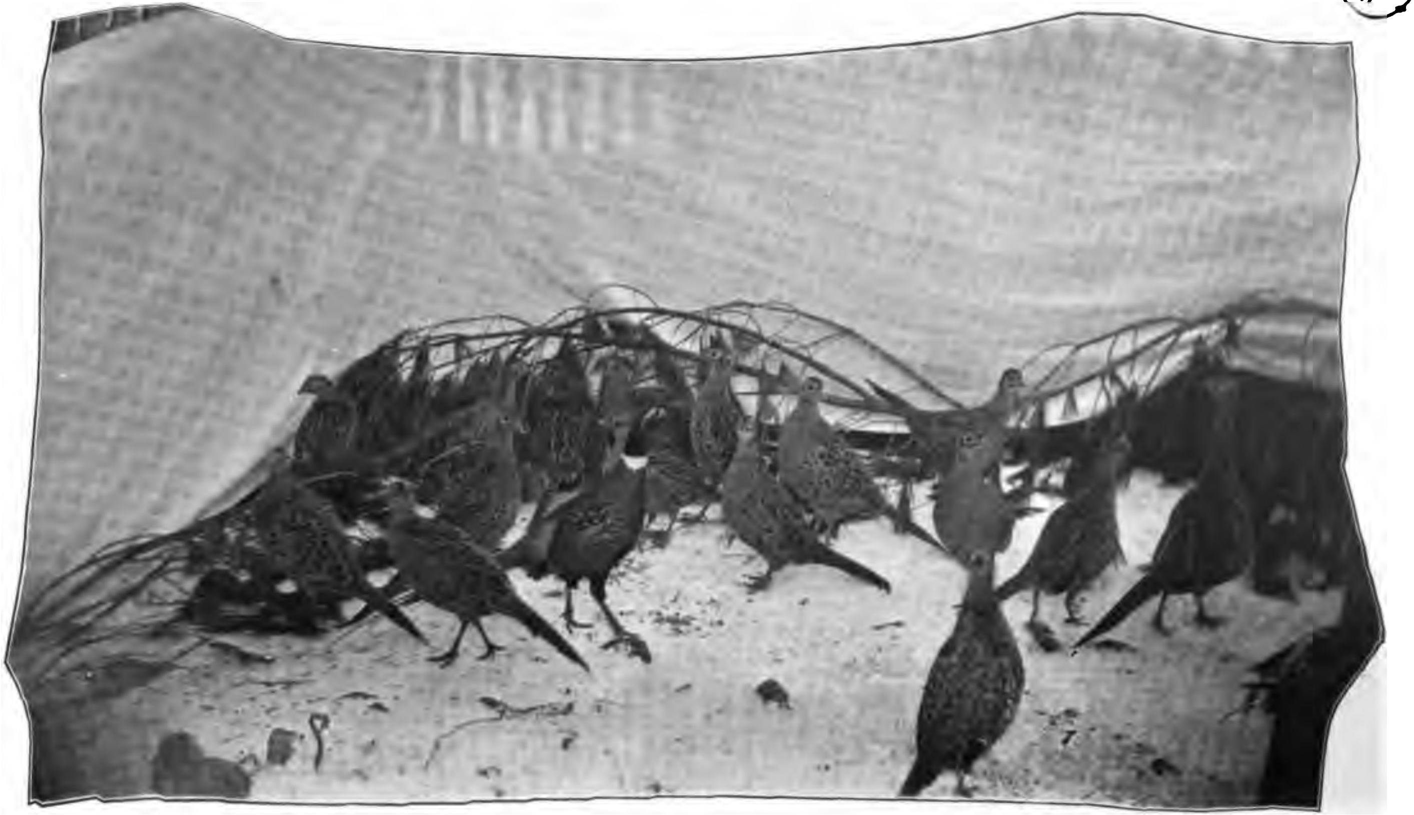

MONGOLIAN PHEASANTS.

good luck, and all said that the season was a record one for birds. They repeated over and over that it was due to the present law, prohibiting the sale of birds, and the strict enforcement of the law by the commissioners."

Sea and Shore Birds. — It is claimed, by those who have been in a position to know, that the opportunities for shooting sea birds have been exceptionally good during the season covered by this report. The special feature this year at Chatham, for instance, was that up to the middle of October at least there was a flight of birds every day, and consequent steady shooting; whereas in other autumns it is conceded that "there have been days of exceptional shooting which would more than equal any day this season, but on that one particular day the big bags had to be made, or not at all." As many as twelve to fifteen coots have been commonly killed in a morning by the local sportsman at North Chatham, and one hunter "bagged eight coot and six shelldrake." Fine bags of yellowlegs, peeps, grass birds, etc., were also obtained. Conditions more or less similar to those above described prevailed along the south shore and elsewhere where sea and shore birds are generally sought.

Pheasants. — Evidence of a gratifying increase of pheasants within the Commonwealth, and of their breeding successfully in a wild state, have been numerous and convincing. It is practicable to mention only a few of these, but the statements that follow demonstrate the capacity of the Mongolian pheasant not only to live in our climate but to multiply rapidly. The success of the hen pheasants in rearing large broods shows conclusively that in an effort of this kind the natural instincts of the mother bird excel the best achievements of man.

Mr. W. G. Pray of Topsfield wrote as follows regarding pheasants, on September 25: "Pheasants have bred well this season, and within a radius of twelve miles there are fifteen broods and from twelve to fifteen in a brood. . . . There are a number of broods in Topsfield, and the teamsters tell me that they start them in the road almost every day."

A gentleman who has watched with interest the work at Winchester informed Commissioner Brackett that he had found a pheasant's nest early in the season, in a secluded place near enough for him to keep it under observation. Twenty-one eggs were laid in it, and these produced nineteen chicks, all of which were raised as long at least as the mother bird could keep them together. In another instance the commission was creditably informed of a young brood at or near Arlington that numbered fifteen.

The pheasant has done well on Nantucket. The "Enquirer and Mirror" of that town, in its issue of September 21, said: "The Mongolian pheasants, which were liberated in the vicinity of Pognoy several months ago, are multiplying rapidly, several large broods of young birds having been discovered this week."

At the other extremity of the State the outlook also seems encouraging.

Deputy Nichols, writing on September 29, states that he had been informed by a well-known sportsman at Turner's Falls that a man had seen two pheasants near that village a few days previous; also that Deputy Brockway of South Hadley had stated that a farmer living near where the pheasants were liberated last spring, in the last-mentioned town, saw an old bird and ten young ones a few days previous to the date of Mr. Nichols's letter.

Hon. I. M. Small of North Truro, in a letter dated Oct. 26, 1901, makes the following statement: "A beautiful cock pheasant was seen in the field between our house and the lighthouse last Tuesday, quite likely one of those which you put out here last spring."

Deer. — There are many evidences that deer are increasing in this State to a satisfactory degree, and that they are widely distributed. Occasionally one is killed by accident or design, but the persistency with which the deputies have investigated all complaints of deer being illegally killed, or killed in any manner, undoubtedly has had a tendency to prevent many, who otherwise might have hunted deer, from engaging in so hazardous an enterprise.

A herd of twenty-six deer was seen in April on the Massachusetts side of the Vermont line, according to Deputy Nichols; but from information at hand it appears that these deer were near the State boundary in the vicinity of Pownal, Vt., and consequently were liable to be in either State, as they moved back and forth to graze or to find shelter congenial to them. When last reported they were within this State.

The Pittsfield "Journal" of October 24 had the following in reference to deer in the northwestern part of the State: "Four deer have been seen in the vicinity of Williamstown in two days. Sunday two deer ran from the woods near the State line and trotted along the highway for a considerable distance, when they disappeared in the brush beside the road. Early Monday evening Motorman Pandle saw two fine deer near the home of Mr. Briggs, on the road to Blackinton. Mr. Pandle was running his car, when the deer jumped out upon the track and then bounded away."

As indicating the presence of deer in the northwestern part of the State, the following item from the North Adams "Transcript" of May 28, 1901, may be quoted: "The east-bound express which passes through here at 5.18 in the morning struck and killed a large deer just west of Blackinton to-day. The animal weighed about two hundred and fifty pounds, and is one of the largest that has been seen in this vicinity. Game Warden Nichols was notified, and took charge of the carcass, bringing it to the city." It is somewhat remarkable that a deer was struck by an electric car a few days earlier, not far from where the express train hit the one referred to.

Deputy W. J. Cross of Becket stated, on July 9, 1901: "Deer are seen every few days, all the way from one to five."

Referring to Ludlow Centre, in his report for the week ending June 23, Deputy John F. Luman makes the following statement: "Deer are very abundant here. They are seen every day by the farmers, one of whom told me that his wife tried to drive one into the barnyard, thinking it was one of the young heifers. There were a doe and her young feeding close to the barn. The farmer's dog chased both and was gaining on the young one, when the mother turned upon the dog and nearly killed him."

In its issue of October 23 the Worcester "Telegram" published the following despatch from its Palmer correspondent: "Three handsome young deer were seen in the woods along the track of the Central Vermont Railroad this morning by Timothy Davis, who was walking across the tracks to his pasture. The deer were feeding along the track, and were within one hundred feet of him when discovered. They did not seem to pay any attention to him, and appeared very tame. Two others were seen by W. W. Thomas near West Ware, and Edgar Squiers saw two more on Moulton Hill, Monson. Judging from the numerous deer that have been seen in this section of the country this fall, it will not be many years before persons will not have to go to Maine to hunt them. No less than twenty-five deer have been reported as seen in this locality so far this fall."

Deputy George W. Chaney of Dunstable reports: "Deer are quite numerous in the spring and summer months; in fact, two or three of them have frequented my mowing fields day and night for the last two years, and . . . three, four and five have been seen by different persons in the highways at one time by several persons. My father has lived in this section for eighty-one years, and never saw anything like it before."

Complaints of the abundance of deer have been received from farmers, who claim that their growing crops have been injured by the animals. Other evidences of the increase of deer are too numerous to be quoted here, and they are sufficient to indicate that the protection given by the State has resulted satisfactorily; it has demonstrated the feasibility of keeping this beautiful wild animal within our State borders, and if the chasing of it by dogs can be prevented, there is no doubt that we can ultimately have deer to hunt in Massachusetts for a few days at least in each year.

It will thus be seen that the game conditions in the State indicate much advancement, and, with some hoped-for improvement in the protective laws and adequate means for their enforcement, there is reason for anticipating much in the future which until now seemed almost hopeless. A more complete understanding of the game situation will be obtained by reading the annual reports of the deputies, which are published in the appendix, and are supplementary to the statements made in the foregoing paragraphs.

Breeding Game Birds and Animals.

Winchester. — The breeding of game birds and animals at the State experiment station at Winchester has been carried on as usual, but, for reasons specified in the following paragraphs, the success with birds came short of expectation.

Pheasants. — The past season has been very unfavorable

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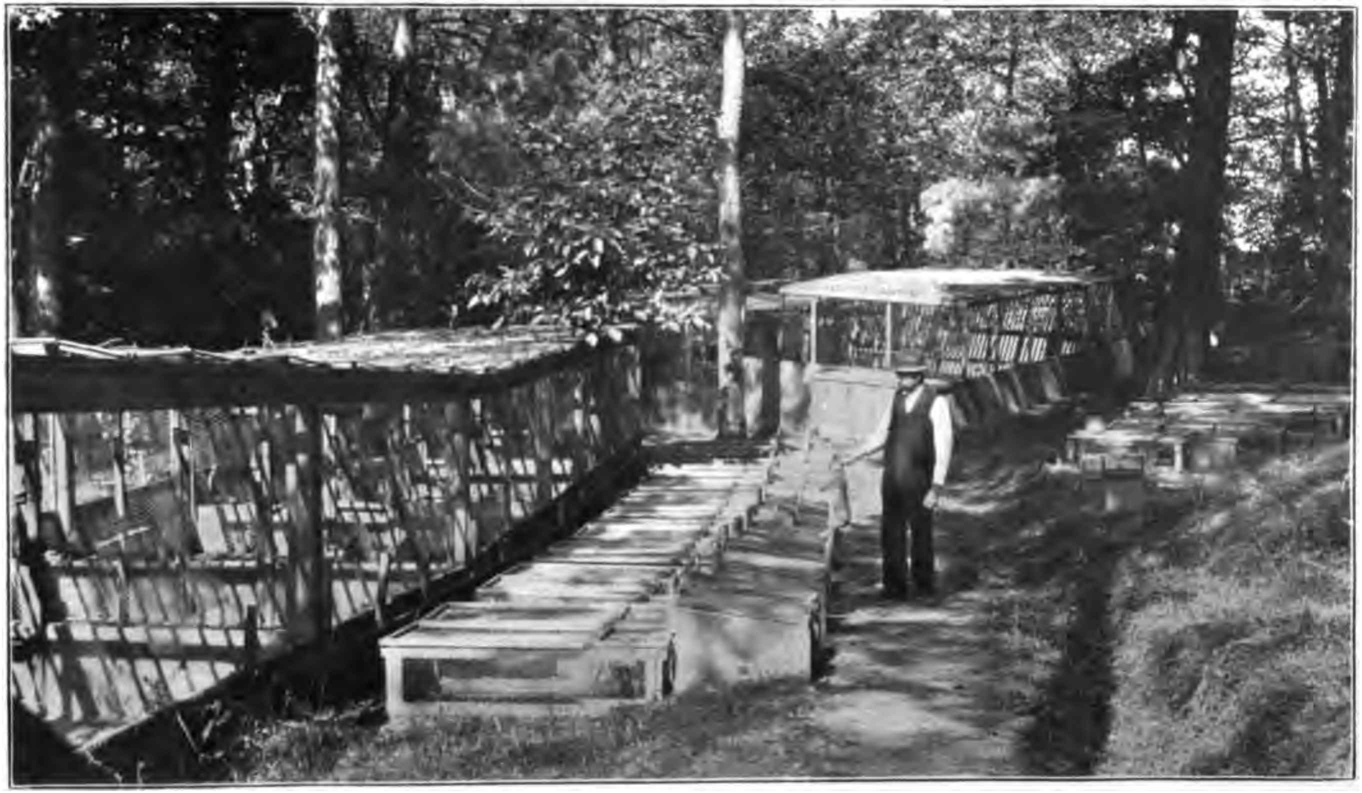


BELGIAN HARE PENS AND PHEASANT COOPS AT WINCHESTER.

for the artificial rearing of all kinds of birds. Owing to the warm weather of the previous fall, they molted late, and consequently had not recovered their usual vitality when winter overtook them. The spring was cold and wet, extending into June. Many of the eggs were not fertile, and many more lacked the vitality necessary for a continued life. The consequence was that the anticipations for a large increase in the number of pheasants at the station were not realized.

The Mongolian pheasant is a wild, restless bird, requiring a great deal of exercise and the widest range possible. By frequent experiments it has been found best to give the chicks, after the first five or six days, the liberty of the large enclosure. They grow faster and in every way are superior to those raised in small coops. They not only retain their instinct of self-preservation to a large extent, but learn to forage for themselves, and do not depend entirely on the hand of the superintendent for their food. As they grow older they will often fly over the fence into the adjoining woods and fields, but, if not caught by their enemies, will invariably return to the enclosure, and in the fall can be easily trapped for distribution or for confinement in winter quarters.

The experiments with the new food were continued this year. This is a granulated food, in appearance closely resembling that which is sold under the name of "grape-nuts." For feeding young birds, a lightly cooked custard without sugar was thickened with the granulated food until sufficiently dry to crumble. Beginning when they were five or six days old, about one hundred pheasant chicks were fed once a day on this food and twice on maggots. As pheasants are not naturally grain feeders, and as young chicks are reluctant to feed on anything that is not alive, it was necessary to teach them to eat the food by mixing maggots with it. They soon acquired a taste for it, and the effect was apparent, as they made rapid growth, began molting early, and when trapped in the fall were larger than any of the same age heretofore raised at the station.

As these birds had their liberty in the large enclosure, and were not always under close observation, it was thought advisable to try the new food with birds in confinement. Accordingly, thirty chicks were placed in the brooder house with small yards, and fed in the same way; but unfortunately, when three or four weeks old, a herd of migratory rats dug into the brooder house, and in one night killed twenty-six. The remaining four were more or less demoralized, yet one of them, a male, has made a phenomenal growth.

Until they are fully feathered out, young pheasants should not be fed on farinaceous food unless it is thoroughly cooked. In a state of nature the mother bird, although she may be a seed or grain feeder, never makes the mistake of feeding her young on such food.

The dissection of young birds shows that the gizzard, which is the most important organ in their digestive system, is not sufficiently developed to enable it to take care of hard food; and this condition holds good, more or less, in the natural evolution of all bird life; consequently, the breeder who adheres most closely to nature will always obtain the best results.

Having partially failed in the experiment with the new food in consequence of the raid of rats, the following experiments were made with partridge-cochin and bantam chickens, both of which are considered rather difficult to raise: —

Lot No. 1: Eighteen cochins and fourteen bantams, hatched May 20, were put in a brooder and fed with food usually given to chickens; only twelve survived.

Lot No. 2: Twenty-six Pekin bantams, hatched July 7, were placed in a brooder and fed on the granulated food; one was deformed, and was killed; twenty-five lived.

Lot No. 3: Thirty-five bantams and thirteen cochins, hatched July 22, also fed on granulated food; forty lived.

The food for the last two lots was carefully weighed and measured, and the cost estimated at about thirty cents per week for seventy birds. The growth and feathering was remarkably fine and rapid. Lots 1 and 2 were weak birds, many had to be helped out of the shell. Lots 2 and 3 were fed for the first four weeks on granulated food (minus the custard), at which time they were fairly feathered, and the food was changed to one less concentrated. Had they been fed on ordinary food in the beginning, probably more than one-half would have died, as was the case with No. 1. In no sense can this be considered a survival of the fittest, but of the most favored; and we strongly suspect that this is true of all forms of life.

It is well known that the most trying time in the life of all birds is the molting season, which varies with different species; that of the pheasant and quail is in August and September, and the common fowl in September and October, the time depending somewhat on conditions and temperature. Dropping their old feathers and having to produce a new garb, in addition to providing for their ordinary requirements, is a drain on their endurance, and, if not properly fed, they either die or go into winter quarters in a condition so reduced that they do not recuperate sufficiently by spring to transmit vitality to their eggs. This is true of old birds, and doubly so with very young birds that have no reserve strength to draw upon. Every breeder knows the value of unchecked growth in the development of life. It was with the hope of meeting these requirements to some extent that the study of and experimenting with food was undertaken. That we have succeeded in some degree is evident from results obtained with pheasants and bantams; but, while we are to that extent satisfied with the results attained, and see no reason why they should not be conclusive, we are aware that no scientific deduction should be made unless it is based on an accumulation of facts. One thing, however, is settled beyond question, — the use of maggots and granulated food is of the greatest importance in rearing Mongolian pheasants. The experiments will be continued on a larger scale next year.

Ruffed Grouse. — Unfortunately, we were unable to obtain eggs to continue experiments with grouse at Winchester this year.

The Belgian Hare. — The remarkable rabbit craze that recently swept over the country has apparently subsided. Elaborate advertising caused a temporary boom that has not been sustained. Many books were published, giving directions how to breed and care for these animals. The breeder was cautioned to avoid all currents of air, as it was sure to produce snuffles. Nor must the animals be given green food, as it would cause slobbers. Then followed thirty or forty different prescriptions for sick rabbits, conveying the idea that these animals are very dependent upon continuous medical treatment. Rabbits reared under conditions thus suggested are wholly unfit for food, and should not be used for that purpose.

It is to be regretted that the Belgian rabbit was not put on the market at its true value. The reaction which is likely to follow the attempts to breed it for speculative purposes, and under unnatural conditions, may for a time retard the proper development of an enterprise that must be considered an important factor in the production of a very desirable article of food.

In order to aid those who wish to promote this industry along rational lines, we give the method which has been successfully pursued at the Winchester station. The breeding rabbits are placed in small yards, framed and covered, sides, top and bottom, with wire netting. The top is movable, in order to facilitate feeding and to clean the yard. To this yard is attached a box about fourteen by twenty inches, and fifteen inches deep; bottom covered with wire netting; top slightly sloping, and water-tight. These yards and boxes are set in open ground, where they are exposed to all climatic changes. As they are light, they can be easily moved if necessary. The box is used for breeding, but rarely for any other purpose. The rabbits are given a handful of oats in the morning, and late in the afternoon as much green food as they will eat. When green food cannot be had, they are given chopped hay, preferably clover, and bran moistened and allowed to stand three or four hours before feeding. Fresh water is kept before them at all times, except when there is snow. The young are allowed to run out into the large enclosure when they are three weeks old.

These directions are so plain that any one can understand them, and whoever follows them, if he gets a hardy strain of rabbits to start with, will have no difficulty in raising healthy stock, suitable for food, which should be the only proper object for breeding these animals, except it be to stock covers so as to increase the numbers of small game.

We are not confident that success will be attained with hutch-bred rabbits, for our experience with them has not been encouraging. Last June, a friend who had bought some fine stock, with a long and celebrated pedigree, brought a doe and six young ones to the Winchester station, and requested the superintendent to care for them while he was on his vacation. He was told how they would be cared for, and replied, "If they cannot stand that treatment, I do not want them." The doe and five young ones died in less than three weeks, although our rabbits thrived wonderfully under precisely similar conditions.

The experience at Winchester shows that the Belgian hares bred by the State are perfectly healthy and more easily raised than the common barnyard fowl. The stock was turned over to the State in the spring of 1900. There were three old and four young does, and from this small stock there have been more than two hundred distributed, and we have now twenty-eight breeders and over sixty young rabbits in various stages of growth. The remarkable feature of our work in breeding the Belgian hare has been the absolute immunity from disease of any kind. A few very young rabbits that were exposed to the heat of a broiling mid-summer sun suffered from sun-stroke, and some died; but this only indicated that they were subjected to excessive and unnatural conditions. In a state of nature they would have been sheltered. And this, too, despite the fact that the promulgated "directions" of "expert" breeders have been ignored, and the animals have been raised under natural conditions of climate, and in other respects have been treated in a common-sense manner. If nothing else results from breeding these rabbits by the State, the information obtained is worth much more than the experiment has cost; for it has been clearly demonstrated that these animals can be bred and reared by the farmer with as little trouble as poultry, and with probably greater profit, if healthy animals are first secured for breeders, and methods similar to those adopted by the State are followed.

It is of course too soon to reach any conclusion as to the result of the efforts to stock the State covers with rabbits; in the natural order of things it will be some time yet before a correct estimate can be made of what may be accomplished in this direction. Meanwhile, the demand for the Belgian hare for liberation in the wilds comes from all sections of the State, and the applications are so numerous that it has not been possible to comply with them all. They indicate the popularity of the attempt the commission has made to increase the numbers of our small game animals, and also that fears of the State being overrun with rabbits is not troubling the average person.

stage as those attained to at Winchester last season; but then they all died in a short time.

Report of Superintendent. — The following report of the superintendent of the station presents in detail the facts connected with breeding and rearing pheasants, and also contains allusions to certain experiments and observations which are interesting in this connection: —

State Fish Hatchery,
Wilkinsonville P. O. (Sutton), Mass., Nov. 25, 1901.

To the Commissioners on Inland Fisheries and Game.

Gentlemen: — For the present season, 36 pheasants, 9 males and 27 females, were reserved for breeding purposes, and were divided into nine lots, each lot consisting of 1 male and 3 females. Two females died before the beginning of the laying season, reducing the number in pens Nos. 3 and 4 to 2 each. The distribution of the birds among the pens is shown in the following table, together with the production of eggs credited to each pen: —

	Two-year-old Birds.		One-year-old Birds.						
	Pen No. 1.	Pen No. 2.	Pen No. 3.	Pen No. 4.	Pen No. 5.	Pen No. 6.	Pen No. 7.	Pen No. 8.	Pen No. 9.
Hens, ...	3	3	2	2	3	3	3	3	3
Eggs, ...	111	96	96	35	89	59	53	75	68

The average was $27\frac{9}{25}$ eggs per bird, while it was $36\frac{2}{7}$ last year. This shows a very marked decrease, for which the young birds seem to be responsible, although the two-year-old birds laid less than they did a year ago. It is quite certain that in Pen No. 1 the eggs were laid by only 2 birds, as the third one laid marked eggs, and these, being soft-shelled, were not counted. I believe it is very important that advantage be taken of the opportunity afforded, by keeping records of each pen, to make a selection of breeders by discarding such birds as those in pens Nos. 4, 6 and 7, and not only reserving the better lots, but from the best rearing the stock that is intended for breeding in the future.

From 682 eggs 281 chicks hatched; the 401 eggs that failed to hatch were mostly fertile, but contained weak embryos. Of the chicks reported hatched, 100 were helped from the shell, and 42 of these died the first day, because of the weakness that destroyed so many embryos in the shell. The rest of the loss, which was 140, was equally divided between the mortality from ordinary causes and the unaccounted loss, which is largely due to crows. From the oldest lot of chicks 25 were taken by crows between the end of the first week and the time they were confined, which was at the age of four weeks; during the same time only 4 died in the coops. The loss from ordinary causes was less than usual, except in some of the younger lots, and in those was caused by lice, which is surely preventable. The reason for the presence of vermin was due to the necessity of getting setting hens from many different places. Most of the hens were free from vermin, but a few thus troubled were sufficient to infest the whole lot. When the youngest chicks had attained the age of one month, the number on hand was 100. In September, 40 of these were distributed; which, with the subsequent loss of 19, reduced the number of young birds on hand to 41, of which 15 are males and 26 females. Of the old pheasants, 6 males and 25 females survive. To fill the pens, 2 females and 3 males should be reserved; and, taking into consideration the probable loss, several beside these should also be held, thus leaving 30 of the young birds for distribution.

The loss of birds over the age of one month has been 30, which seems unnecessarily heavy. The chief occasion for it I believe to be the unsuitableness of the breeding pens for confining immature birds, and especially the height of the pens, or the cover. The last named has caused the loss of many of the finest birds by concussion and consequent broken necks. Tests of roomy temporary pens, made to enclose weedy ground which seemed especially adapted to the needs of chicks, gave most decidedly satisfactory results.

Two lots of birds confined in pens like that last referred to have excelled all others in growth and vigor, and, although these are now confined in the small pens, they still keep ahead of the others. One lot, the youngest and weakest, outstripped all but the oldest lot, which was likewise experimented with, and fewer of its numbers died than of any lot. Two of the principal causes of loss — the destruction of the chicks by predatory birds and animals and the loss of half-grown birds by close confinement in the pens — are avoidable, and, occurring, as they usually do, when the chicks have passed the age at which they are subject to heavy unavoidable loss, are very severely felt. The use of pens, such as those referred to, which can be very cheaply made and can be easily moved to fresh ground, will doubtless save the most of the birds which otherwise are liable to be lost after the third week.

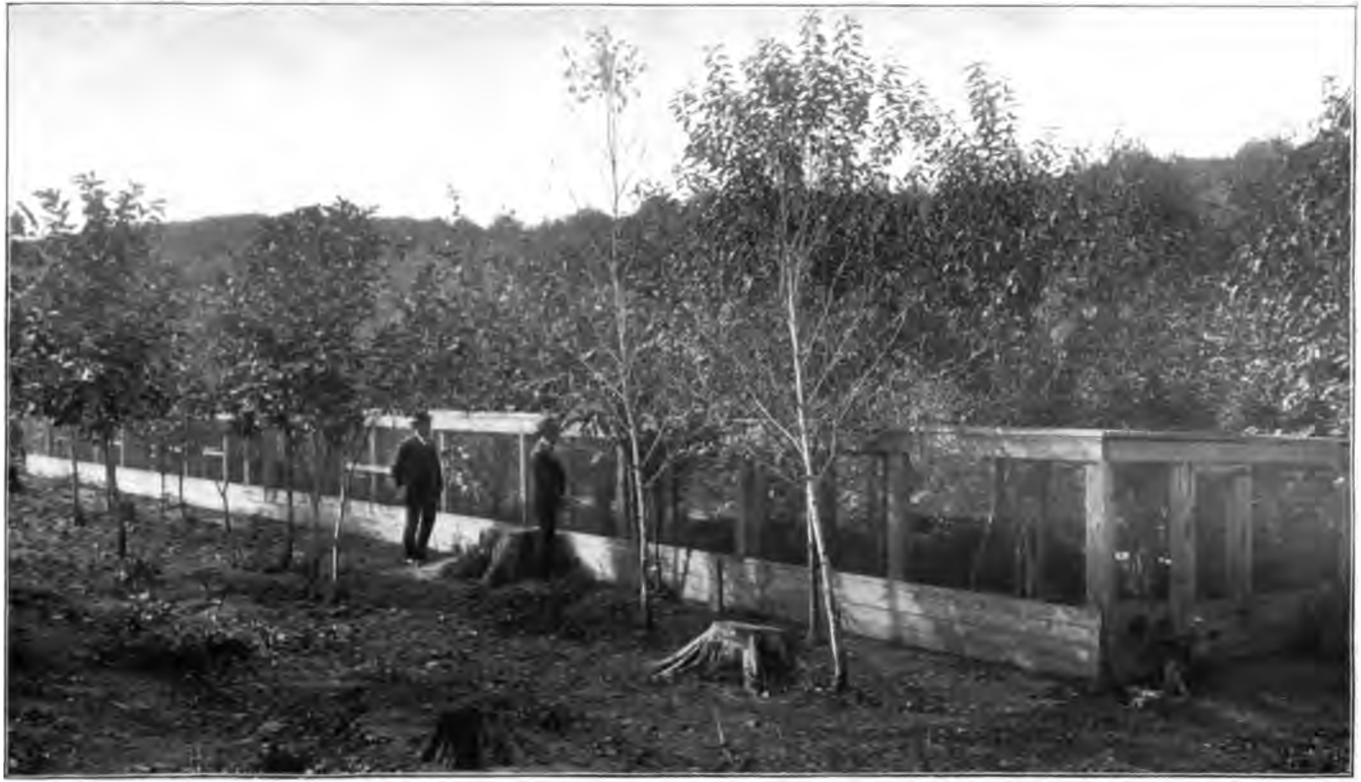
The pens made for experimentation were enclosures of boards and poultry netting, and covered with fish-netting, the cost of which was about one cent per square yard. The sides of the enclosures need not be expensive, for they can be made very low, and the cover can be elevated on poles, tent fashion, to give room. Enclosures like this can be used until snow falls; at that time the pheasants are well developed and hardy, and will safely endure closer confinement.

The heavy loss of eggs was due to obscure causes, and the only conclusion that can now be reached in regard to avoiding it in the future is to increase the vigor of the brood stock; it being probable that the weakness of the embryos, to which the failure to hatch seemed due, was a consequence of the lack of desirable vitality in the breeding birds, and this seems also manifested in the comparatively small number of eggs laid. The first lot of eggs hatched gave good results, — 85 chicks from 94 eggs. The second lot went to the other extreme, only 6 chicks hatching from 86 eggs. On examination, the eggs were found to be as fertile as those in the previous lot, but the embryos had died before full development. In all the succeeding lots the embryos were fully developed, but in most cases they were too weak to emerge from the shell. From 400 eggs only 100 chicks hatched without assistance; besides these, there were 100 that were helped from the shell, to which reference has already been made, and 100 were taken out too weak to survive for even a few hours. The hatching was done under such varying conditions, with results so nearly unvarying, that it is quite certain nothing in the condition of the weather, the arrangements or place for hatching, was responsible for the loss incurred.

While the pheasant pens are not satisfactory, it is difficult to suggest any way in which they may be improved, and the only thing I would advise in connection with them is, that measures be taken to keep visitors at a proper distance. The pheasants are so wild in the breeding season, and are so frequently frightened by visitors who come here in great numbers, that it is certain much harm must result if there are no restrictions. An inexpensive fence placed at a suitable distance from the pens will probably accomplish what is desired.

To determine what form of pen is best, I suggest that an experimental one be constructed, embracing the features which in the temporary pens gave such desirable results, and that the eggs of a trial lot of breeders placed therein be hatched, and the chicks reared separately. The weeds that gave such excellent cover for the young might not do for the old birds, but a location can be easily found where bushes will serve the same purpose.

The food for the young pheasants was changed by the addition of unsweetened custard, and the results were satisfactory; the loss under the third week was greatly reduced, and only very rarely could be attributed to the food, or inability to assimilate it. Maggots were fed to the usual extent, and as the chief ration. The custard could be kept before the birds at all times, and the brood was thus strength-



PHEASANT COOPS AT SUTTON.

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ened by more frequent feeding, and this also enabled the weak ones to feed as often as any. With maggot feed exclusively the weaklings frequently failed to get what they needed, and died in consequence.

In this season's work it was found to be of great advantage to let the chicks have a good wide range. When a brood of young pheasants had unrestricted range, without the competition of bantam chickens or older pheasants, they made a marked gain over those confined to restricted areas; though the advantage thus secured was to some extent neutralized by the greater exposure of the chicks to their enemies, and for this reason it was sometimes impracticable to let the birds have their liberty.

Respectfully, ARTHUR MERRILL.

Distribution of Game Birds and Animals. — During the year 368 pheasants have been liberated in the covers of the State, in response to the requests of 55 applicants. The list of applicants and points of distribution are given in the Appendix. This distribution far exceeds in numbers anything heretofore accomplished by the commission in this direction, and is due primarily to the expansion of the work, especially at Sutton; but also to the fact that it has been considered desirable to liberate all the birds available for distribution, and not to winter any except those reserved for breeding purposes.

The output of hares has been 224; in addition to those, a considerable number of young have been retained for wintering, as has been mentioned elsewhere. The list of persons whose applications were complied with and the points of distribution are shown in the Appendix.

So great has been the demand for the distribution of these birds and animals that it has been impracticable to comply with all the applications, despite the large increase in the output of pheasants and the number of rabbits liberated. In all cases pheasants and rabbits are liberated by the deputies of the commission, and only in the covers suitable to them. In no case are they sent to private persons, to be retained in confinement. In order to insure uniformity of action and a clear understanding of the requirements, the following instructions regarding the distribution of pheasants and hares were supplied to every deputy entrusted with this duty: —

Deputies entrusted with the distribution of pheasants or hares will go by the most direct and expeditious routes, and will see that the birds or animals in their charge are properly placed in cars, etc., to insure their safety. Each deputy will be provided with a letter to conductors or others that will insure such courtesies as are commonly accorded to the State by transportation agencies. This should be shown to officials.

Pheasants and hares are to be placed in the woods or in the brush, where they can run wild. It is not permissible to leave them in restricted enclosures or pens, where they will not have liberty of flight, etc. With this in mind, deputies will co-operate as fully as possible with those to whom shipments of birds and hares are sent, in the proper distribution of the animals or pheasants in their charge.

When pheasants are put out during seasons when food is not easily available to them, the deputies will advise that some suitable food be thrown out daily near the spot, so that the birds can get it, and thereby be induced to stay in the locality, and also be relieved from the suffering that their unfamiliarity with their new environment may otherwise cost them.

When returning crates or boxes to Winchester by express, take receipt for same, and see that they are properly addressed.

Parties to whom consignments of birds or hares are being shipped should be notified, by wire or otherwise, of the expected hour of arrival at destination.

Proposed Introduction of New Game Birds. — Through the kindness of Rev. Cephas F. Clapp, an effort has been made to introduce from Oregon, for the purpose of artificial propagation, the so-called "mountain quail," or plumed partridge (*Oreortyx pictus plumiferus* Gould).* This is a hardy mountain species, that is found in the comparatively dry elevated regions in the interior of the Pacific coast States and as far east as Nevada. Captain Bendire found it on Mount Kearsarge, Inyo County, Cal., where in summer it reached an altitude of ten thousand feet.†

The following notes regarding its habits are extracted from Captain Bendire's description of the species: —

He considers it a "handsome" bird, and compares it favorably with *O. pictus*, which "is the largest of the American partridges." He found it "a shy and retiring bird, usually to be found only in small coveys, and on being alarmed trusting more to the legs than wings for escape." He considers it "essentially a bird of the mountains, where it is more partial to the open pine forests and rocky ridges, covered with chaparral and undergrowth, than to densely timbered portions of ranges."

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* A closely related species (*Oreortyx pictus* Baird) is also known on the Pacific coast as the "mountain quail;" but, owing to the fact that it is found only in "moist mountainous regions along the coast, where the rainfall is heavy," it is evidently dependent upon climatic conditions that are not found in New England. For this reason it probably would not thrive here.

† "Life Histories of North American Birds," etc., by Capt. Charles Bendire, U. S. A. (retired). Special Bulletin No. 1, U. S. National Museum, Washington, D. C., 1892, p. 14.

It begins to mate "in the latter part of March and the beginning of April, according to latitude and altitude." A brood of young birds, about a week or ten days old, which he came across in June, 1883, were "already handsome and active little creatures," that "scattered promptly in all directions, and the majority were most effectually hidden in an instant."

The maximum breeding capacity of the species was a brood of twenty young birds, observed by Mr. Loren W. Green of the U. S. Fish Commission; but the eggs usually vary from eight to fourteen.

Captain Bendire states that the "food consists of insects, the buds and tender tops of leguminous plants, small seeds, and berries of various kinds; the nest, simply a slight depression in the ground scratched out by the bird, and lined perhaps with a few dry leaves, pine needles, grasses, and usually a few feathers lost by the hen while incubating." *

The reputed hardiness of this species, and the fact that it "buds" in winter, like our native ruffed grouse, prompts the belief that it will thrive in this State. It is claimed that it can be reared in captivity with less trouble than the Mongolian pheasant. If, therefore, it is practicable to secure even a few birds to breed from at the beginning, it seems feasible to soon be in a position to annually turn out a large number, in view of the fact that two litters of eggs may be expected under favorable conditions.

Mr. Clapp unfortunately found a serious obstacle in the law of Oregon which prohibits the transportation of any wild birds of this species out of the State. With the utmost desire to serve us in this matter, he found that he was effectually prevented from doing anything, because the statute, which was enacted to prevent pot hunters from accomplishing the practical extermination of the "mountain quail," proved an effective barrier to its exportation to another State for scientific purposes. Under the circumstances, and in view of the purpose for which the birds were desired, it was considered advisable to invoke the good offices of the Governor of Oregon. Accordingly, a letter was addressed to His Excellency Gov. T. T. Geer, by the chairman of the Board, on Nov. 8, 1901, setting forth the object of this commission in attempting to secure living specimens of the "mountain quail," and expressing the hope that their procurement for transportation out of Oregon for the purpose indicated might not be found contrary to the spirit of the law of that State regarding transportation of game across its boundaries.*

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* *Ibid.*, pp. 14-16.

Correspondence has also been tentatively inaugurated bearing on the possibility of the introduction of the capercailzie (*Tetras urogallus*) and the black game (*T. tetrix*). Both of these are inhabitants of northern Europe, and are among the finest game birds known. The capercailzie belongs to the grouse family, of which our ruffed grouse and prairie chicken are well-known examples in this country. It is the largest grouse known, and considered the noblest game of the grouse family. A weight of ten or twelve pounds is often attained by the full-grown cock. The black game weighs about three pounds, is hardy, and recognized as a fine game species. Like its larger congener, the capercailzie, it is a grouse, and essentially a bird of the woods. These are considered the two most important species of wild birds of the Scandinavian peninsula, considered either from the stand-point of food or sport.

Thomas has considered the question of their introduction here. He writes as follows concerning it: "Will the capercailzie and black game thrive in the United States? On this question I think there can be no reasonable doubt. . . . It is my firm conviction that both the capercailzie and black game will thrive throughout all the wooded districts of New England, New York and Pennsylvania, and westward through the greater portion of the States of Michigan, Wisconsin and Minnesota." *

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* Since the above was written, and while this report is going through the press, arrangements have been concluded whereby birds of this species can be obtained at the proper time.

Attempts to introduce the black game in Maine and Vermont are reported to have been made by private parties; but little is known regarding them, beyond the fact that a very few birds were liberated in the woods, doubtless in a weakened condition, in consequence of the transatlantic voyage, and it is not improbable that they died before the period of reproduction arrived, — at least, we are unable to learn that any birds of this species have ever been seen. If, however, it is practicable to breed either of these species in captivity, — and there appears no reason to doubt it, — entirely different results might be secured by the acquirement of enough of them to inaugurate their propagation under State auspices. All attempts to breed from eggs of these species, shipped from a distance, have resulted in failure. Only adult birds can be relied on, and experiments already made prove the feasibility of their safe transportation. Mr. Thomas estimates the cost of strong, healthy birds of these species at twelve dollars each for capercailzie and seven dollars each for black game.

The familiar quail, or "Bob White," cannot be considered a new species in any sense of the word, since it is one of the best-known and most highly valued of our game birds. But the inauguration of the work of breeding and rearing it in captivity, which is now seriously contemplated, will, if undertaken, be an innovation in the effort the commission is making to keep our covers properly stocked with game birds. Until now there has seemed to be no necessity for the State to breed quail, since there has been no difficulty, as a rule, in purchasing them for stocking purposes. Much has been done in this direction by clubs and public-spirited individuals, and no doubt this commendable effort will be continued if it is feasible to get the birds. But the necessity for increasing the stringency of protective laws in the various States points to the probability that it may not be long before it may be impracticable to obtain in the open markets large numbers of quail for stocking our covers. Whether or not we undertake the breed-

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* "Sweden and the Swedes," by W. W. Thomas, Jr., pp. 342, 343. Mr. Thomas is at present United States Minister to Sweden and Norway, in which capacity he has served this country on former occasions.

ing of quail immediately, it will be wise to be in a position to engage in this work, if necessary, before it becomes difficult or impossible to secure breeding birds. No difficulty whatever is anticipated in breeding and rearing quail, as they can be raised as easy as chickens.

ENFORCEMENT OF LAWS.

Financial Resources. — The appropriation for the enforcement of law was $6,925, and for the first time in the history of the commission was made specific. This was something less than the amount devoted to the same purpose last year. For this reason, and also because the regular salaried deputies were appointed at the beginning of the year, instead of in May, as in 1900, and therefore were on pay twelve months instead of eight, the money available did not admit of appointing as many special deputies on pay for short periods of service as were put on the pay roll last year.

Force employed. — The force for the enforcement of fish and game laws consisted of (1) paid deputies serving throughout the year; (2) special deputies paid for short and varying terms of service, as demanded by the exigencies of the work, who at other times were unsalaried officials; (3) special deputies receiving very little pay from the State, and that only for more or less short periods, and deriving their income chiefly from clubs or through employment as county or town officials; (4) deputies paid wholly by clubs but unsalaried by the State; and (5) unpaid deputies serving without pay from any source.

Five regular paid deputies were appointed at the beginning of the year, and have remained on active duty since. This enumeration does not include Deputy Holmes at Lawrence, whose duties are limited to preventing violations of the law relating to fishways and keeping a record of fish passing over the fishway at that point, and whose salary is $70 per annum; nor does it include the deputy appointed at Yarmouth, on a salary of $50 per year (this being derived from the appropriation for stocking ponds), whose duty relates solely to protecting Mill Pond, which has been reserved by the State for fish-cultural purposes, from poachers who might attempt to fish in it. While it is true that these men are part of the law-enforcing paid officials, they belong to a special local class, with limited responsibilities, and not to the active force of salaried deputies, whose service is continuous and may be required in any part of the State.

Ten special deputies were on the salaried list for more or less short terms, for the most part, however, only during the two months of the open hunting season; some who were paid for longer periods received only nominal salaries.

The highest salary paid was $60 per month, and the lowest $5 per month.* On the whole, the work was conducted with much economy, and with the utmost care regarding expenditures.

The unpaid deputies who received no pay whatever from the State numbered 120. These were not all appointed at the beginning of the year, for appointments were made in every month, even as late as December. The list includes men of many professions, even members of the Legislature and officials of the United States Fish Commission. It is an indication of the earnest desire for the protection of fish and game, when manufacturers, merchants, lawyers, sheriffs, deputy sheriffs, policemen, constables and farmers (not to speak of others) seek the opportunity to do what they can to enforce fish and game laws, if nothing else will suffice; but who, as a rule, prefer to unite a show of authority with good advice and instruction, if the same amount of good can be accomplished thereby.

System adopted. — The system followed this year was similar to that adopted in 1900, varied slightly, however, to meet somewhat different conditions, arising chiefly from a reduced force during that portion of the year — the open season for hunting, and a few weeks previous — when it becomes necessary to prosecute the work most vigorously in all sections of the State.

The distribution of information relating to the fish and game laws is considered among the most efficient means to prevent violations of these statutes; and it is evidently wise and just for the State to inform its citizens, as fully and as promptly as possible, of changes in law and of the restrictions which must be observed in fishing and hunting. Acting on this principle, over 5,000 copies of fish and game laws in pamphlet form have been distributed; 1800 copies of cloth and paper posters containing abstracts of these laws have been placed in post-offices, railroad stations and other public places; and copies of the law relating to returns of fisheries have been sent to every person or corporation known to require one. When it is stated that the number of fish and game laws thus distributed were more than eight times as many as in 1899, the relative magnitude of the present work of this kind will be understood. Nothing that the commission has done has met with fuller public appreciation. This is shown by the demand for this kind of literature, which was considered phenomenal last year, but has since been much exceeded.

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* In this instance the deputy was actively at work, and did efficient service; the bulk of his salary was paid by a club.

In addition to the documents already referred to, the commission has distributed a considerable number of copies of "Laws relating to Inland Fisheries in Massachusetts, 1623–1886." These have been placed in town libraries and elsewhere where they will be available for reference.

Besides all this, abstracts of the fish and game laws have been widely published in the press, as news; more or less extended reference has likewise been made to special laws and to the opening of the game season, and what could be legally done by hunters. The great public interest in these matters has induced the press to become a powerful auxiliary in the diffusion of knowledge relating to legal restriction of fishing and hunting. That all this has resulted in the prevention of many violations of law, and made it almost impossible for one to transgress unwittingly, may be reasonably assumed.* But, while it is generally conceded that there has been a better observance of fish and game laws this year and last than ever before, there have been, nevertheless, more or less violations. For there is always a lawless element among those who hunt or fish; some are indifferent, others defiant, and others hope to escape detection by cunning or adroitness. Unfortunately, there are those who have not yet learned to seriously consider game laws as legal restrictions that actually should be observed as a matter of principle, and because respect is due the law-making power; and, as a result, there is developed sometimes a feeling that it is not a serious error to hunt or fish not in strict conformity to the law. Occasionally a young boy, or a woman unfamiliar with such matters, may err unintentionally, but these are rare exceptions. Those who disregard fish and game laws are usually old offenders or persons disposed to lawlessness, and nothing but the strong hand of the law can be relied on in dealing with them.

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* "The man who kills game or catches fish out of season is either a very cruel or ignorant person; he who wantonly disregards the game laws, well knowing their significance, is a criminal; he who hooks a trout that is about to spawn, trips a doe with her young, or knocks over a bird about to lay or that is already caring for her eggs or brood, and knows not the crime he is committing, is a fool. . . . The first lesson in field sports and angling is the study of the game laws. The bungler's excuse for killing too many birds or taking too many fish — that he did not know the law — is silly. It is the duty of the man who resorts to the gun and rod *to* know the law before he gives trigger or casts his bait. His lack of knowledge on this question is not recognized as a legitimate excuse in court, and the sportsman who hears this sort of a plea knows the culprit is not of the true fieldman's order. The ignorant game law breaker cannot escape punishment by pleading ignorance any more than the wanton destroyer who derives a benefit from the sale of his unseasonable game may go free by pleading poverty. Men are not allowed to tear up whole fields of grain to satisfy one stomach, or rob a needful multitude to clothe one back. To kill a bird in nesting time means the murder of her young as well; the capture of one fish on her spawning-bed is the destruction of thousands of others she is rearing." — Charles Bradford, in Leslie's "Weekly," June 15, 1901.

The most common violations may be classified under three general heads, namely, the illegal capture and sale of lobsters, hunting on Sunday, and illegal fishing.

The plan adopted, as already stated, was generally like that of last year, but, owing to the comparatively small number of paid deputies, it was more difficult to organize parties of these, consequently co-operation of unpaid deputies and local officers was often sought. This has generally been given with much heartiness, and the commission is under obligation to these officials, who have zealously aided in the enforcement of protective laws.

The paid deputies have been continuously on the move, and not only have they been most active in enforcing laws, but they have done good service in distributing fish, pheasants and Belgian hares. For a brief time all the salaried officers, with one exception, were assembled on the coast to enforce the lobster laws; but even then the force was insufficient for the purpose, and could not be kept on the coast long enough, with justice to other sections. Several arrests were made, and for a time there seemed to be a check to illicit trade. Other arrests were made, after the three coast deputies were left to grapple with the problem, and when they worked single-handed or otherwise, as circumstances permitted; but it was beyond their power to do all that was required, even if other duties had not occupied their time to a greater or less extent.

Every possible effort has been made to look after all cases of which complaint has been made. In some instances, when it has been feasible to secure evidence, parties have been arrested for acts unwitnessed by the deputies, and convictions have been secured. In some cases of deer killing, however, the evidence necessary to secure conviction was not obtainable, and nothing could be accomplished. The moral effect of some of these cases was, nevertheless, excellent, for the efforts put forth impressed all familiar with the facts that it is unsafe to disregard the fish and game laws, even if a deputy is not within many miles.

There is available a great mass of material which shows how the laws were enforced, but the limitations of this report forbid the quotation here of extracts from the press, letters and reports.

Two matters connected with the enforcement of the fish and game laws deserve special mention, for the reason that there has been some misunderstanding of the position taken by the commission.

Rulings by the courts in the early part of the year led the commission to inquire of the legal department of the Commonwealth regarding the Sunday fishing law (section 11, chapter 98, Public Statutes), which had been vigorously enforced by our deputies up to that time, since the enforcement of this statute had until then been deemed a duty. The decision rendered, under the authority of the Attorney-General, Hon. Hosea M. Knowlton, held that:—

> The unpaid deputies of the Fish and Game Commission are not entitled to any portion of the fines arising out of convictions for Sunday fishing, for the reason that the statute fixing a penalty for Sunday fishing is not a "law relating to inland fisheries." . . . The statute prohibiting Sunday fishing is P. S., c. 98, § 11: "Whoever attempts to take or catch any fish on the Lord's day, . . . shall be punished by fine not exceeding ten dollars." This section is part of the act of 1865, c. 253, entitled "An act for the better observance of the Lord's day." Manifestly the latter act is not a "law relating to inland fisheries," within the meaning of the former act. Fishing in the open sea is likewise prohibited on Sunday. The enforcement of this act is no more one of the duties of your deputies than the enforcement

of another section of the same act found in P. S., c. 98, § 10: "Whoever on the Lord's day discharges any firearm for sport . . . shall be punished by fine not exceeding ten dollars."

This decision made it clear that the Sunday fishing law is simply a police regulation; that its enforcement is a police duty, — not to be considered one of the duties properly devolving upon the commission. This made necessary a decided change in the scope of law-enforcing work, and led to the issuance of the following circular order, which was sent to all deputies: —

By order of the Board, it is not deemed incumbent upon this commission to attempt the enforcement of the Sunday fishing law, and prosecutions under this law now pending will be withdrawn. This is not to be understood as preventing the arrest of parties fishing on Sunday in ponds closed to fishing on that day, under chapter 208, Acts of 1897, or in brooks wherein fishing is prohibited on Sunday, under chapter 284, Acts of 1900. . . .

Deputies are earnestly enjoined to carefully observe this order.

The circulation of this order led to much misapprehension, due to the fact that statements were published to the effect that the commission was "abrogating" the laws, or words to that effect. This misrepresentation made it necessary to issue the following open letter, which fully explains the position of the commission: —

Recently much that is misleading and inaccurate has appeared in the press regarding the order relating to the enforcement of the Sunday fishing law issued by the Commissioners on Inland Fisheries and Game. As a result of this, there is apparently a misapprehension on the part of the public of the proper relation of the Fish and Game Commission to the law referred to, and its right or duty to enforce it. For this reason it seems desirable and timely that the public should be correctly informed regarding the matter.

Section 1, chapter 91 of the Public Statutes, provides that "all laws relating to the culture, preservation, capture or passage of fish shall be known as the laws relating to inland fisheries;" and section 3 of the same chapter provides, among other things, that "each of the commissioners may personally or by deputy enforce all laws regulating inland fisheries." These provisions of law have heretofore been deemed sufficient warrant by the commissioners to conclude that they might justly assume that the law relating to Sunday fishing (section 11, chapter 98 of the Public Statutes) was a law "relating to the . . . preservation" and "capture . . . of fish," and therefore that it was not only their right, but that it was incumbent upon them, to enforce this law. As a consequence, the law has been as vigorously enforced as any fish and game law on the statute books, until it was considered necessary to take other action. But recent rulings of the lower courts, backed by a decision of the Attorney-General of the Commonwealth, establishes beyond question the fact that the statute prohibiting Sunday fishing "is *not* a 'law relating to inland fisheries,'" and that the enforcement of this act (Public Statutes, chapter 98, section 11) is no more the duty of one of our deputies "than the enforcement of another section of the same act found in Public Statutes, chapter 98, section 10: 'Whoever on the Lord's day discharges any firearms for sport . . . shall be punished by fine not exceeding ten dollars.'" A later statute (chapter 116, Acts of 1899) gives the commission full authority to prevent hunting on the Lord's day, and this will be enforced; but this law gives no power to the Board so far as Sunday fishing is concerned.

The Fish and Game Commission has no choice but to act in accordance with law, as interpreted by the courts and the highest official legal authority in the State, nor has it any purpose other than to abide by such decisions. Its authority for the enforcement of law being definitely limited to fish and game laws, and the recent rulings and decisions having established the fact that the law relating to Sunday fishing is "An act for the better observance of the Lord's day," and not a fish law, it was manifestly our duty to instruct our deputies not to enforce a law which we have no right to enforce. To ignore court rulings and the decision of the highest legal authority in the State would be manifestly an error, to call it by no harsher name; consequently the action taken by the commission is in strict compliance with law, and the wild tales that it has attempted to "set aside or repeal" the laws of the Commonwealth are too absurd to merit notice.

The repeal of chapter 138, Acts of 1891, at the last session of the Legislature, was ambiguous, so far as the practical application of the repealing act is concerned, and caused a wide difference of opinion, even among those most proficient in law, as to whether or not the close season for trout in Berkshire, Hampshire, Franklin and Hampden counties should begin on August 1 or on September 1. The commission was compelled to decide not to interfere with trout fishing in the counties referred to until September 1, pending further legislative action. This matter was definitely settled at the special session in November of this year; the close season for trout fishing begins on August 1 next year in the four western counties mentioned.

Result. — As a result of the enforcement of fish and game laws during last year and this, the snaring of birds has been practically stamped out; Sunday hunting has been reduced to a minimum, as compared with other years; the marketing of partridge and woodcock, or their transportation out of the State, has been largely stopped; and a reasonable respect for the majesty of the law — as applied to the protection of fish and game — has been developed. The exception to this is found chiefly among the lobster fishermen and some of the dealers, who are self-destructive, so far as their industry is concerned, and some of them knowingly so. There are other violations, as has been shown elsewhere, for we are far from ideal conditions, and there doubtless have been cases of selling birds illegally. But these are the exceptions, and it may safely be asserted that the conditions to-day, so far as maintaining a respect for the fish and game laws is concerned, have never been so good as they are now.

That those entrusted with the enforcement of these laws, and especially the paid force, have been efficient and reasonably zealous is evidenced by the fact that 156 arrests have been made; 134 convictions have been secured, with penalties amounting to $1,678.16.

NEW LEGISLATION.

It is of the utmost importance that the right of search should be given to the commission for the better enforcement of the fish and game laws, and also that ferrets illegally used or found in illegal possession should be confiscated. It is impossible in many cases to fully apply the law without some provision of this kind. This is too obvious to require elaboration. For this reason we recommend that the following be enacted into law: —

SECTION 1. For the purpose of enforcing the provisions relative to the protection of fish and game, either of the commissioners on fisheries and game, personally or by deputy, may search suspected persons or places for, seize and remove fish or game taken, held or offered for sale in violation of any of the fish or game laws; or may seize, remove and destroy any ferret held or possessed in violation of law.

SECTION 2. All acts or parts of acts inconsistent herewith are hereby repealed.

Section 22, chapter 92 of the Public Statutes should be amended so that it will read as follows: —

Whoever, except as provided in the preceding section, takes, carries, sends or transports, or causes to be taken or transported out of this Commonwealth any of the birds or animals protected by the provisions of this chapter, which have been illegally taken or killed therein, or has in possession such birds or animals, or either of them, with intent to take or cause the same to be taken out of the Commonwealth, shall be punished by a fine of twenty dollars for every bird or animal so had in possession or taken or caused to be taken or sent beyond the limits of the Commonwealth as aforesaid.

COURTESIES.

This commission has received from the United States Fish Commission consignments of eggs of brook trout, rainbow trout, landlocked salmon and pike perch; also special statistics of its fish-cultural work in this State, and various publications, statistical and otherwise.

The post-office authorities have courteously continued permission to display in the post-offices in the State posters containing abstracts of fish and game laws. A similar favor has been shown by the management of the New York, New Haven & Hartford Railroad, which has permitted the display of fish and game law posters in their stations throughout the State.

The various railroads traversing the State; particularly those lines controlled by the Boston & Maine and the New York, New Haven & Hartford companies, have very generously carried, free, shipments of fish, birds and animals intended for distribution or for propagation. The following circular was issued by the Boston & Maine Railroad: —

BOSTON, MASS., April 22, 1901.

To Station Agents, Station and Train Baggage Masters.

Whenever fish, eggs or young fish in cans, pheasants or Belgian hares in crates, are presented at your station for transportation by

authorized agents of the Fish Commissioners of Massachusetts, New Hampshire, Vermont, Maine, or the United States Fish Commissioners, you will forward the same in baggage cars without charge, provided a person accompanies each shipment who holds transportation for himself. Train baggage masters will allow the person in charge of the shipment to ride in baggage cars with the same whenever desired.

Empty cans and crates will be returned to original starting-point without charge.

Whenever shipments are made, the forwarding agent will advise this office, giving number of cans or crates, and destination.

C. J. WIGGIN,
General Baggage Agent.

All that has been necessary to ensure compliance with this order, or similar instructions on other roads, has been an official certificate from the commission that the fish, birds or Belgian hares, for which free transportation is sought, are the property of the State.

Acknowledgments are due Hon. Andrew H. Morrison, Mr. N. B. Everett, Mr. Charles M. Bryant, Hon. Arthur E. Roberts, Hon. Joseph E. Love, Hon. John H. Casey and others for courtesies extended to the chairman on his visits to various sections of the State for the examination of ponds, etc.

Mr. Thomas L. Burney has presented to the commission the following mounted specimens: prairie chicken, ruffed grouse, pair of black game (male and female), and model of partridge snare with snared bird on it.

Mr. A. M. Nichols has presented the commission with a mounted specimen of a quail, and a photograph of a female partridge on her nest.

The commission has been privileged to extend courtesies in the following instances: —

To the United States Fish Commission, permitting the collection of egg-bearing lobsters; the operation of a pound net for scientific purposes, etc.

The Japanese legation in Washington was supplied, in compliance with its request, with copies of the last report of this commission.

The commission has been able to grant facilities to Mr. W. E. Castle of the Museum of Comparative Zoölogy, at Cambridge, in order to assist him in solving certain scientific questions.

Letters of introduction to prominent merchants and vessel owners at Gloucester have been furnished to H. Kato of Japan, who is visiting this State to study its fisheries, and brought a letter of introduction to the chairman of the commission.

Deputy Thomas S. Holmes has been authorized to collect lampreys to be used for scientific purposes by the following persons: Prof. J. Percy Moore, University of Pennsylvania, Philadelphia, Pa.; and Prof. E. L. Mark, Director Zoölogical Laboratory, Harvard University, Cambridge, Mass.

Permits have been issued to the following parties to collect birds and eggs: J. Bion Richards, Fall River; Owen Durfee, Fall River; A. C. Bent, Taunton; Mabelle A. Brown, Haverhill; Robert O. Morris, Springfield; George H. Mackay, Nantucket; Charles F. Batchelder, Boston; Fred H. Kennard, Boston.

Fourteen permits to take sand eels for bait have been issued to the following citizens of Newburyport, and one to a citizen of Salisbury: Charles F. Lattime, W. H. Simmons, Joseph Thurlow, Charles R. Couillard, Frank L. Rogers, Albion P. Hilton, Warren G. Caswell, Charles A. Caswell, C. C. Adams, R. E. Pierce, Eldon G. Noyes, Stephen Caswell, Charles H. Small and Albert H. Leet, of Newburyport; and William H. Pierce of Salisbury.

J. W. COLLINS.
E. A. BRACKETT.
J. W. DELANO.

APPENDIX.

[A.]

LIST OF COMMISSIONERS.

UNITED STATES COMMISSION OF FISH AND FISHERIES, WASHINGTON, D. C.

George M. Bowers, Commissioner.
Irving H. Dunlap, Chief Clerk.
Hugh M. Smith, Assistant in charge of Division of Inquiry respecting Food Fishes.
W. de C. Ravenel, Assistant in charge of Division of Fish Culture.
C. H. Townsend, Assistant in charge of Division of Statistics.

Superintendents of United States Fisheries Stations.

Charles G. Atkins, Craig Brook, East Orland, Me.
E. E. Race, Green Lake, Me.
John W. Titcomb, St. Johnsbury, Vt.
Waldo F. Hubbard, Nashua, N. H.
C. G. Corliss, Gloucester, Mass.
E. F. Locke, Wood's Hole, Mass.
J. Nelson Wisner (in charge), Battery Island, Md.
L. G. Harron (in charge), Bryan's Point, Md.
John E. Brown (in charge), Central Station, Washington, D. C.
George A. Seagle, Wytheville, Va.
Alexander Jones, Erwin, Tenn.
S. G. Worth, Edenton, N. C.
J. J. Stranahan, Cold Spring, Bullochville, Ga
Livingston Stone, Cape Vincent, N. Y.
S. W. Downing, Put-in-Bay, O.
Frank N. Clark, Northville, Mich.
S. P. Wires, Duluth, Minn.
R. S. Johnson, Manchester, Ia.
Dr. S. P. Bartlett, Quincy, Ill.
H. D. Dean, Neosho, Mo.
John L. Leary, San Marcos, Tex.
DeWitt C. Booth, Spearfish, So. Dak.
E. A. Tulian, Leadville, Col.
James A. Henshall, Bozeman, Mont.
H. H. Buck, Baker Lake, Wash.
Edgar N. Carter, Clackamas, Ore.
Giles H. Lambson, Baird and Battle Creek, Cal.

ARKANSAS.

H. H. Rotaken, President,	Little Rock.
W. B. Worthen, Secretary and Treasurer,	Little Rock.

CALIFORNIA.

H. W. Keller, President,	Santa Monica.
W. W. Van Arsdale,	San Francisco.
W. E. Gerber,	Sacramento.

COLORADO.

Game and Fish.

Charles W. Harris,	Denver.
A. A. Gordon, Secretary,	Denver.
T. J. Holland, Superintendent of Hatcheries,	Denver.

CONNECTICUT.

George T. Mathewson, President,	Thompsonville.
Robert G. Pike,	Middletown.
E. Hart Geer,	Hadlyme.

DELAWARE.

E. G. Shortlidge,	Wilmington.
J. Thomas Lowe,	Little Creek.

FLORIDA.

John Y. Detwyler, President,	New Smyrna.
John G. Ruge, Secretary,	Apalachicola.

GEORGIA.

A. T. Dallis, Superintendent of Fisheries,	LaGrange.

ILLINOIS.

Nathaniel H. Cohen, President,	Urbana.
S. P. Bartlett, Secretary and Superintendent,	Quincy.
A. F. Gartz,	Chicago.

INDIANA.

Z. T. Sweeney,	Columbus.

IOWA.

Fish and Game.

George E. Delavan, Warden,	Estherville.

L. and A. S. Peterson, Assistants.

KANSAS.

George W. Wiley,	Meade.

MAINE.

Fish and Game.

L. T. Carleton, Chairman,	Winthrop.
Henry O. Stanley,	Dixfield.
Edgar E. Ring,	Orono.

Sea and Shore Fisheries.

A. R. Nickerson,	Boothbay Harbor.

MARYLAND.

Jesse W. Downey,	New Market.
Clarence L. Vincent,	Snow Hill.

MASSACHUSETTS.

Joseph W. Collins, Chairman,	Boston.
Edward A. Brackett, Secretary,	Winchester.
John W. Delano, Superintendent of Hatcheries,	Marion.

Office, State House, Boston, Mass.

MICHIGAN.

F. B. Dickerson, President,	Detroit.
H. W. Davis,	Grand Rapids.
George M. Brown,	Saginaw.
Seymour Bower, Superintendent,	Detroit.
George D. Mussey, Secretary,	Detroit.
J. H. Johnson, Treasurer,	Detroit.

MINNESOTA.

Game and Fish Commissioners. (Office at Capitol.)

Uri L. Lamprey, President,	St. Paul.
W. P. Hill, Vice-President,	Fairmont.
D. W. Meeker, Secretary,	Moorhead.
H. G. Smith, Treasurer,	Winona.
S. F. Fullerton, Executive Agent,	St. Paul.

MISSOURI.

Samuel T. Rathell, Chairman,	St. Louis.
Dr. P. L. Hurt,	Boonville.
J. R. Hairston,	Fayette.
E. P. Yenawine,	St. Joseph.

J. T. Crisp,	Independence.
Philip Koplin, Jr., Superintendent,	St. Louis.
M. E. O'Brien, Superintendent,	St. Joseph.

NEBRASKA.

Game and Fish Commission.

Ezra P. Savage, Commissioner,	Lincoln.
George B. Simpkins, Chief Deputy,	Lincoln.
W. J. O'Brien, Superintendent of Hatcheries,	South Bend.

NEW HAMPSHIRE.

Nathaniel Wentworth, Chairman,	Hudson Centre.
W. H. Shurtleff,	Lancaster.
C. B. Clarke,	Concord.

NEW JERSEY.

Howard P. Frothingham, President and Treasurer,	Pompton Lakes.
William A. Halsey,	Newark.
Benjamin P. Morris,	Long Branch.
Richard T. Miller,	Camden.
George Riley, Protector,	Newark.

NEW YORK.

Forest, Fish and Game.

Timothy L. Woodruff,	Brooklyn.
DeWitt C. Middleton,	Watertown.
Charles H. Babcock,	Rochester.
John D. Whish, Secretary,	Albany.

OHIO.

J. L. Rodgers, President,	Columbus.
A. J. Hazlett,	Bucyrus.
C. E. Buroker,	St. Paris.
Albert Brewer,	Tiffin.
J. C. Burnett,	Sabina.
L. H. Reutinger, Secretary and Chief Warden,	Columbus.

OREGON.

Fish Commission.

Governor, T. T. Geer,	Salem.
Secretary of State, F. I. Dunbar,	Salem.
State Treasurer, C. S. Moore,	Salem.
L. P. W. Quimby, Game and Forestry Warden,	Portland.
H. G. VanDusen, Master Warden,	Portland.

PENNSYLVANIA.

Fisheries Commission.

S. B. Stillwell, President,	Scranton.
D. P. Corwin, Secretary,	Pittsburgh.
H. C. Demuth, Treasurer,	Lancaster.
James A. Dale, Corresponding Secretary,	York.
John Hamberger,	Erie.
James W. Correll,	Easton.

Game Commission.

William M. Kennedy, President,	Pittsburgh.
C. K. Sober,	Lewisburg.
James H. Worden,	Harrisburg.
E. B. Westfall,	Williamsport.
Charles B. Penrose,	Philadelphia.
J. O. H. Denney,	Ligonier.
Joseph Kalbfus, Secretary,	Harrisburg.

RHODE ISLAND.

J. M. K. Southwick, President,	Newport.
Henry T. Root, Treasurer,	Providence.
Charles W. Willard,	Westerly.
A. D. Mead, Brown University,	Providence.
William P. Morton, Secretary,	Providence.
Adelbert D. Roberts,	Woonsocket.
William H. Boardman,	Central Falls.

UTAH.

John Sharp,	Salt Lake City.

VERMONT.

John W. Titcomb,	St. Johnsbury.
E. A. Davis,	Bethel.

VIRGINIA.

Frank Fletcher, Chairman,	Jenkins Bridge.
Seth F. Miller, Secretary,	Foster.
John A. Curtis,	Richmond.
George B. Keezell,	Keezelltown.
Pembroke Pettit,	Palmyra.

WASHINGTON.

Governor, John R. Rogers,	Tacoma.
State Treasurer, C. W. Maynard,	Tacoma.
A. C. Little, Commissioner,	Tacoma.

WISCONSIN.

Governor, Robert M. LaFollette, ex-officio,	Madison.
Edwin E. Bryant, President,	Madison.
William J. Starr,	Eau Claire.
Calvert Spensley, Treasurer,	Mineral Point.
James J. Hogan,	La Crosse.
Henry D. Smith,	Appleton.
Currie G. Bell,	Bayfield.
Edward A. Birge, Secretary, ex-officio, Professor of Zoölogy, University of Wisconsin,	Madison.
James Nevin, Superintendent,	Madison.

WYOMING.

Albert Nelson, State Game Warden,	Grovont.
S. H. Campbell, Superintendent Fish Hatchery, District No. 1,	Laramie.
C. W. Morgareidge, Superintendent Fish Hatchery, District No. 2,	Sheriden.

[B.]

A REPORT UPON THE SCIENTIFIC BASIS OF THE LOBSTER INDUSTRY, THE APPARENT CAUSES OF ITS DECLINE, AND SUGGESTIONS FOR IMPROVING THE LOBSTER LAWS.

BY DR. GEORGE W. FIELD, LECTURER ON ECONOMIC ZOÖLOGY IN THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

LETTER OF TRANSMITTAL.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY,
BOSTON, Dec. 18, 1901.

Hon. J. W. COLLINS, *Chairman, Department of Fisheries and Game.*

MY DEAR SIR: — In accordance with the request of His Excellency Governor Crane, and of your honorable commission, I have prepared a concise report upon the scientific basis of the lobster industry and the apparent causes of its decline, and have suggested a plan for future legislation.

In its preparation I have been influenced by no considerations whatever except a sincere desire to forward the best interests of the whole Commonwealth, by checking the rapid decline of the lobster supply and by restoring the lobster to the position it once held as a wholesome and delicious food for the people at large, rather than to permit it to become merely a delicacy for the tables of the rich.

From the scientific point of view I find that the cause of the decline appears to be a simple one, viz., that we are catching the wrong lobsters. We should protect the adults instead of the young. In most other industries which furnish food for man we use the scientific and therefore common-sense practice of keeping adult plants and animals for seed and breeders, and use the young as food; as, for example, in the case of the domestic fowl, geese, turkeys, ducks, pigeons, cattle, pigs, etc., and with lettuce, cabbage, beets, turnips, sweet corn and other garden vegetables. In other cases, where there is an over-supply of mature plants or animals, we save "enough for seed" and eat the others, — wheat, corn, potatoes, sheep, etc. In many other cases besides that of the lobster the neglect to follow this rule has led to a noticeable decline, viz., in trout, game, clams, etc., and in time protection of adults must probably be applied to all useful species.

It is believed that this report will show the correctness of some at least of the opinions of those who favor a close season; and of some of the opinions of those who favor a 9 or a 10½ inch law; and by indicating how these various opinions should be reconciled and brought together in one law based upon science and a knowledge of human necessities, as well as of the natural history of the lobster, some small service may have been performed.

Respectfully yours, GEORGE W. FIELD.

EVIDENCE OF THE DECLINE.

Convincing evidence of the decline of the lobster supply meets any one who makes an unbiassed canvass of the question, or even compares the conditions in 1880 and 1901. Trustworthy figures show that the annual catch in the United States has diminished from 31,000,000 pounds in 1889 to 15,000,000 pounds in 1899, — a loss of 52 per cent. This loss is borne directly by the fishermen. Meantime, the cost at first hand to the consumer has more than doubled, — a burden which falls upon the people who should use lobsters as food or bait, while at the same time this increased price does not make good the loss to the fishermen.

The continued shrinkage of the lobster crop aroused serious apprehension as early as 1874. Discussions as to ways and means to check the decline and remedy the defects, even then already evident, crystallized into legislation. The present lobster laws came into existence for the definite purpose of maintaining an adequate supply of lobsters for the local population. The persons immediately interested are not fishermen and lobster dealers alone, but the entire population. It is not, therefore, a question to be dealt with upon personal or selfish grounds, either in the interest of certain individuals or classes or communities. Action should be based upon broad and correct economic principles, upon scientific practice and common sense, upon definite and adequate knowledge of the value of the lobster as a commodity and a food, of the possibilities and legitimate demands of the lobster industry, of the conditions imposed by the natural history of the lobster, and of the laws of human economy, rather than upon any merely transitory, arbitrary, personal, local or political considerations.

CAUSES OF THE DECLINE.

The causes of the growing scarcity and the yearly diminishing average size of the lobsters caught are found in: (1) *The natural demand*, arising from an increasing population and from the stimulus of culinary ingenuity, resulting in salads and the chafing dish. This legitimately increased *demand has not been met by a correspondingly increased source of supply.* (2) *The existing laws,* for the reason that the destruction of adults has been permitted. The present laws, with their practical difficulties of enforcement, have had an adequate trial. The decline of the lobster industry demonstrates that these laws have proved inefficient for increasing or even for maintaining the supply, and for the bettering of the conditions to meet which these laws were instituted. The chief defect of the present laws seems to lie in permitting the destruction of adults.

That the industry is one which is worthy of the deepest concern and most careful consideration is evinced by the magnitude of these fisheries, the financial returns therefrom, and by the widespread interest, and even solicitude, of the public, when the facts of the decline of the industry and the growing scarcity of lobsters become unmistakably evident. The statistics of the United States Fish Commission for 1900 indicate that in New England and New York State 4,348 men gained a livelihood from the lobster trade; and that the value of the catch at first hand was $1,390,579 in Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut and New York. But in addition to those directly engaged in the industry practically the entire population is immediately interested in the lobster either as a source of income or as a delicious food. The class numerically and financially most interested is the great consuming public, because it is to-day compelled to pay four or five times the price current thirteen years ago, and too often is forced to forego altogether this wholesome and palatable food, which was formerly readily available to the workingman. Man himself has made the lobster to-day a rich man's delicacy; while the total financial returns to the fishermen have, on the average, constantly diminished, at least in Massachusetts, for the reason that the increased scarcity has more than wiped out the profit from the increased selling price, and to-day intelligent and honest fishermen are finding themselves deprived of a means of livelihood by the failure of the lobster fishery. It is to protect these men who already have time and money invested in the lobster industry, and above all the consuming public, that adequate laws have become necessary.

SUGGESTIONS FOR REMEDIAL LEGISLATION.

Of the suggestions for legislation to check this decline, seven, either singly or in combination, appear to be especially prominent: —

1. A close season for a portion of each year, or for a term of years.
2. The continuance of the present 10½ inch law, under more effective enforcement.

3. The substitution of a 9 inch law.
4. The prohibition of the killing of egg-bearing lobsters.
5. The prohibition of the killing of any female lobsters.
6. The removal of all restrictions as to catching.

And finally, as an entirely new proposition, which I personally venture to advance, —

7. The protection of *all adult* lobsters above the breeding age, and the removal of restrictions on the catching of the immature which are of satisfactory marketable size.

It is self-evident that a just and adequate law should be one which meets the most requirements, wherever identical conditions obtain; and if such a law can be devised, the chances of securing uniform legislation throughout the lobster-producing districts will be vastly improved.

An impartial balancing of the merits and defects of the several propositions is here attempted: —

1. *A Close Season.* — (*a*) For a portion of the year. This is usually the first resort, based on the argument that, inasmuch as a decline is caused by the killing of too many individuals, a close season must tend to restrict the number killed; and if the killing is entirely prohibited during the breeding season, the number of young which may be produced is likely to be increased. A close season may bring very manifest and satisfactory results in cases when the animal is a rapid breeder, or where the young reach maturity in a short time, say within one year. But it is by no means safe to argue that therefore a close season is equally applicable for checking the numerical decline of every, or any particular, animal. This is notably true of the lobster. A close season must fail to bring the expected results, for the reason that the lobster is a slow breeder, laying eggs but once in two years, and carrying these eggs, attached to the modified legs under the abdomen, for ten or eleven months after laying; while the young require probably from four to seven years to reach maturity and to attain a length of 7 to 10 inches.

Even in Massachusetts there may be practical difficulties in deciding upon a date for beginning and ending the close season, on account of the various opinions as to how long such a close season should be, and from the fact that the lobster catching begins south of Cape Cod earlier than it does on the north shore. This ground for discord increases somewhat if the regions for which uniform laws are necessary are as far separated as New York and Newfoundland.

Further, since the lobster breeds but once in *two* years, and carries the eggs from ten to eleven months after laying, it manifestly can make no difference to the race whether the young are destroyed as unlaid eggs, as eggs recently laid or as eggs just on the eve of hatching. The chief value of the close season to the lobster is that fewer lobsters may be caught; but the lobstermen and the public bear the burden, while the lobster does not get a commensurate benefit.

A further defect of a close season during a portion of the year is the fact that the lobster is especially convenient for human food during the warm season, and there has been found thus far no satisfactory substitute; the cost and practical difficulties of transportation, apart from other considerations, shut out for the present the crayfish, crabs, shrimps and the spiny lobster of our southern coast.

Finally, the fundamental defect of a close-season law is that it restricts the demand but does not adequately and economically increase the supply. The aim of sound economic legislation should be to increase the supply without limiting the demand. Laws prescribing close seasons, restrictions in times and methods of catching, prohibition of canning or otherwise limiting the demand should be the last resort, and then only after it has been found that efforts to increase the supply are futile.

Aside from the practical difficulties of securing a close season throughout the lobster range, and enforcing the laws, the value of the close season to the lobster as a race is commensurate with the duration of this close season. The longer it extends, the better for the lobster but the worse for man. The burden upon investments in the lobster fisheries is increased. The absence of the lobster from the human food supply is felt by the public. Yet all this is of little avail, for the effects of the close season are not permanent. The causes of the decline have not been removed. The lobsters, through a close season, either from one to six months each year, or for a continued series of years, may have a chance to "catch up," only to be themselves "caught up" with redoubled energy, resulting in a glutted market, and consequent economic waste for a time, with the certainty of a rapid return to the former conditions which made a close season necessary.

(*b*) Close season for a term of years. Most of the foregoing statements apply also to a close season of a term of years. The primary inherent defects in the close season are that it does not reach the cause of the decline, and it fails to recognize the fact that the lobster can and should be reckoned as a perennial and perpetual food for man. Human efforts can so control conditions that the supply may be large or small. In my opinion, by taking proper measures the lobster supply can be made abundant and continuous, instead of intermittent.

2 and 3. *Continuance of Present Length Law or Substitution of Another.* — The 9 and 10½ inch laws are the ones which have met widest favor. They are identical in inconvenience of application and

in difficulty of enforcement. So far as aiding the maintenance of the lobster supply, the advantage is with the 10½ inch law, for the reason that it gives the lobster a chance to breed once or perhaps twice more than does the 9 inch law. Further, the 9 inch law exposes to capture a greater number of individuals, and is therefore the worse for the lobster and better for man. "The worse for the lobster" must, however, be interpreted as being also worse for the future of the fishery; and "the better for man" understood as better only in a purely selfish sense,— better to-day, but plainly discounting the future, and tending to remove the lobster from our list of available foods.

Neither the 9 inch law in New York, the 9 inch and "female lobster with spawn attached" in Connecticut, 9 inch and a closed season in Rhode Island, 10½ inch in Massachusetts, 10½ inch and "female lobsters while carrying their spawn or hatching their young" in New Hampshire, 10½ inch since 1897 in Maine, nor the 10½ inch and a closed season from June 30 to January 14 in the Maritime Provinces, has prevented the continued rapid decline in (1) the number of lobsters caught, (2) the average size of the lobsters caught, (3) the average number of egg-bearing females reported, (4) the number of persons who can depend upon the fisheries for support, or (5) has checked the rapid rise in the price of lobster meat.

Further, these laws have been found by experience to be difficult of application and expensive in enforcement and alike disagreeable to officer and offender. The comparatively unimportant difference in the size limits (9 inches and 10½ inches) has led to considerable local excitement, petty bickering and jealousies, and not a little "practical politics," with unfortunate results.

The sole apparent merit of this law seems to be that it does prevent the catching of some lobsters; just how many is dependent upon the honor of the fishermen and the means of enforcing the law. Its greatest defect, and from a scientific point of view an irreparable one, consists in the fact that it affords no protection to those lobsters which most need protection, —the mature breeding individuals, — but rather puts a premium on their capture through tacitly specifying that only adults *above* the breeding age shall be killed. What would be the effect upon our supply of poultry and eggs if a law should be made "protecting" poultry under one year, or under a certain size or weight? It absolutely ignores the biological laws which man has found by experience to be of utmost importance whenever it has become necessary to increase the natural food supply to meet the increasing population, —the protection of the adult animal in order to secure a supply of young of that species.

Some of these biological principles which should be considered in this connection are: —

(*a*) Human experience indicates that the world's demand for food is continually increasing. This condition must be met by increasing the supply rather than by limiting the demand.

(*b*) Man is a particularly destructive agent when he comes as an enemy of the breeding plant or animal, and almost inevitably upsets the equilibrium of nature and causes a decline in the source of supply (wild food plants and animals), until artificial cultivation or restrictive laws protect the mature breeding plants or animals which alone can maintain the supply.

(*c*) Man has met these conditions by the domestication of certain plants and animals, and by devising artificial methods of increasing production, through propagation and care of the breeding adults and the growing young.

(*d*) A basal necessity is either to save sufficient seed to ensure a crop for the following year, or to protect the adult breeding plants or animals to ensure progeny. The plants or animals are used as food only when they are of least value as breeders, — before sexual maturity or during the age of decline, — or when for any reason a local surplus of breeding animals exists.

4. *The Prohibition of the Killing of Egg-bearing Lobsters.* — To prohibit the killing of any egg-bearing lobsters is good legislation so far as it goes, but it is open to the objection that it pushes into prominence the temptation to comb off the eggs, and thus make the lobster a marketable one. It has practical difficulties of enforcement.

5. *The Prohibition of the Killing of Any Female Lobsters.* — The prohibition of the killing of any female lobster would promise more effectiveness were it not for the fact that it involves catching, and a subsequent sorting and liberation. Though this sorting can be done quickly and easily, a lobster in the hand is not willingly parted with, and the temptation is very great to keep every lobster until the proximity of an inspector threatens.

6. *The Removal of All Restrictions as to Catching.* — The proposal to remove all restrictions as to catching lobsters must inevitably lead to destruction of the industry, unless a sufficient artificial supply can be maintained to meet the demand, and thus far this seems impracticable. Certainly satisfactory results have not been reached in the case of the lobster, though further investigation and examination must yield far-reaching results.

7. *The Protection of All Adult Lobsters above the Breeding Age, etc.* — The method of protecting all the adults, and catching only a portion of the young, promises very satisfactory results in the case of the lobster, for the reasons: —

(1) That the period of immaturity is long. Professor Herrick found that the rate of growth varies with individuals and with the

surroundings. At the time of hatching about ⅓ of an inch long (7.84 mm.), the young increases at each moult about 15.3 per cent.; moults fourteen to seventeen times during the first year, and after twenty-five to twenty-six moults, in about five years, it becomes a 9 to 10½ inch lobster, and reaches sexual maturity,

(2) That the ratio of the biological, *i.e.*, reproductive, value increases very rapidly after the size of 9 to 10 inches has been reached, as shown by Professor Herrick's table. The majority of lobsters begin to lay eggs when 8 to 10 inches long, from 5,000 to 10,000 eggs once in two years; at 12 inches long, about 20,000; at 14 inches long, about 40,000. The largest number of eggs recorded by Herrick is 97,440, for lobsters 15 and 16 inches long.

(3) The number of enemies diminishes very rapidly as the lobster increases in size. The surface-feeding fish swallow the just hatched fry by the thousand. After six or eight weeks the scattered survivors eke out a precarious existence under and among the rocks, a prey to numerous fishes, crabs and even their own brethren. For the next two or three years life is ever full of dangers, particularly from the bottom-feeding fish, — the cod, sea bass, etc.; but the number of enemies becomes rapidly smaller, and if the lobster escapes, and 8 inches is reached, a green old age and a life of biological usefulness through propagating a normal number of descendants are practically certain. Almost the sole enemy is man; but he is worse than all others combined, for he steps in and thwarts nature at the very moment of her triumph. By continued killing of the adults he may exterminate, indeed, he has already wiped out, entire races and species, such as the great auk, Steller's sea cow, etc.

SUGGESTIONS FOR NEW LEGISLATION.

The logical basis, then, for the law necessary to ensure the continuance of our lobster supply, is: —

1. *Protect the adults. Catch only the small lobsters*, not the large ones.

2. Protect enough of the young to ensure a sufficient number of adults.

3. Protect those below a size which experience has shown to be adapted for economic use, say 6 inches.

4. Use only a legal standard pot, having the opening of such size as to prevent the entrance of a lobster say above 9 or 10 inches, and with slats far enough apart and numerous enough to insure the escape of all lobsters less than about 6 inches. Fix a date when all pots shall conform to the standard.

5. Penalize the possession or sale of lobsters above 10 inches and below 6 inches, and of pots not conforming to the legal standard.

6. Discourage the use of the lobster as bait for fish.

7. If possible, combine the above with the longest practicable closed season, for the purpose of permitting the lobster to regain the normal numbers in the shortest time. The protection of adults may then be expected to be effective in maintaining the supply of young, and thus prevent the rapid decrease which would inevitably follow at the end of a close season; and, by furnishing a continual steady supply, relieve the condition of "either a feast or a famine," which so often accompanies close-season laws. The prohibition of the taking of any female lobsters, whether with or without eggs, will be an additional advantage.

8. Establish a State committee, to co-operate with similar committees from the other lobster-producing States and the British Maritime Provinces, for considering the advantages and possibilities of uniform lobster laws, for co-ordinated investigations of the important economic facts in the natural history of the lobster, and for devising improved methods of artificial lobster culture. Rhode Island is obtaining very valuable and practical results on some important phases of the question under the direction of Professor Mead.

The chief apparent objections are: —

(1) That such a proposal as has been outlined is too radical, too great a departure from precedents and from the laws in force in other States. To this it may be answered that the existing lobster laws have little common-sense foundation; they have been based upon misconceptions, and often, no doubt, upon ignorance and local politics; they are directly contrary to scientific experience, and the continued decline of the lobster industry has proved them to be ineffective for the purposes for which they were instituted. They are based neither upon the laws of human economy or the natural history of the lobster.

(2) It has been claimed that "such laws as those proposed would lead to the capture of all the lobsters." At first an actually greater number of lobsters would undoubtedly come into the market; but the increased number of individuals killed would not result in such an increased weight as to materially affect market conditions, and the productive capacity of the protected individuals would be expected to more than offset the apparent loss from the marketing of immature individuals. In other words, the actual value of one adult above 10 inches long in potential productive capacity is many times that of one between 6 and 10 inches long, and man could use as food a larger number of 6 inch lobsters without doing the biological damage which results from the killing of a single lobster of from 9 to 11 inches long, and at the same time have actually a greater weight of lobster meat. If it is feared that under this proposal the lobster

does not get sufficient protection, make the limit still narrower, — say from between 8 or 9 inches to 6 inches.

(1) Such a law would be relatively easy of enforcement, through the inspection of lobster pots.

(2) It would work a minimum injury to vested interests, since sufficient time can be given to make all pots conform to the standard.

(3) It does not remove the lobster from the market, and so does not interfere with the immediate or future interests of fishermen, dealers and consumers.

(4) By protecting those lobsters which are of greatest biological value the interference with natural laws of increase is minimized.

(5) It furnishes a basis for uniform legislation throughout the lobster-producing section. Being based upon common sense, and in close conformity with the natural history of the lobster and with human scientific experience in food supplies, it commends itself to fishermen and others who know human nature and the lobster in a practical way.

Finally, the proposed law, while fundamentally scientific, is eventually a compromise measure, and combines the advantages (1) of a close season throughout the year for a part of the lobsters (*i.e.*, for those productive adults above a size to be agreed upon) and (2) of the size limit, thus meeting the wishes of the believers in both the 10½ and 9 inch laws. It seems to promise effectiveness in meeting existing conditions and in checking the decline. It is adapted for ready enforcement without resort to methods distasteful to officers and people, and at a minimum expense to the State.

[C.]

DISTRIBUTION OF FOOD FISH.

BROOK TROUT FRY.

Winchester Hatchery, April and May, 1901.

APPLICANT.	Name of Waters.	Town.	Number.
Clarence P. Abbott,	Brown Brook,	Groveland,	5,000
Isaac D. Pope,	- -	Danvers,	5,000
Nelson J. Cole,	Taylor's Brook,	Acton,	5,000
Nelson J. Cole,	Rocky Brook,	Acton,	5,000
Nelson J. Cole,	Cemetery Brook,	Acton,	5,000
Nelson J. Cole,	Law Brook,	Acton,	5,000
Geo. W. Alcott,	Flint Brook,	Tyngsbury,	5,000
Caleb L. Smith,	House Brook,	Chelmsford Centre,	5,000
Richard Taft,	Fay's Brook,	Dracut,	5,000
Chas. O. Hall,	Richardson Brook,	Dracut,	5,000
Geo. L. Huntoon,	Double Brook,	Dracut,	5,000
Geo. B. Clark,	Trap Hole Brook,	Walpole,	10,000
J. E. Plimpton,	Lewis Brook,	Walpole,	5,000
Jas. H. Jones,	Moonakis Brook,	Falmouth,	10,000
E. J. S. Miller,	Robbin's Brook,	Concord Junction,	10,000
H. F. Hathaway,	Elm Brook,	Bedford,	10,000
Oscar I. Stowell,	Meadow Brook,	Lynnfield,	15,000
Geo. G. Rogers,	Wine Brook,	Burlington,	5,000
Wm. H. Keleher,	Clapp Mill Stream,	Woburn,	5,000
Jas. F. Dogherty,	Citizen's Brook,	Woburn,	5,000
Arthur P. Dickson,	Amesea Brook,	Woburn,	5,000
Jas. E. Bowtell,	Seward Brook,	Woburn,	5,000
Walter D. Lepper,	Jericho Brook,	Marlborough,	5,000
Roswell Wetherbee,	Smith Brook,	Lincoln,	5,000
Geo. H. Sweetman,	Elm Brook,	Bedford,	10,000
A. B. Clark,	Hodkin's Brook,	Ipswich,	10,000
Chas. A. Wiggin,	Goldthwait's Brook,	Peabody,	5,000
Samuel Parker,	Saugus River,	Wakefield,	10,000
D. J. Wetherbee,	Nashoba Brook,	Acton,	10,000
Arthur E. Roberts,	- -	Reading,	10,000

Sutton Hatchery.

W. H. Gale,	Hedge Brook,	Warwick,	5,000
F. L. Hagar,	Beman Brook,	Winchester,	5,000
J. S. Ames,	Peter's Hill Stream,	Hubbardston,	10,000
E. J. McKnight,	Cook's Brook,	Templeton,	5,000
Wm. Pratt,	Bailey Brook,	Gardner,	5,000
A. E. Knowlton,	Poor Farm Brook,	Gardner,	5,000
M. M. Lawler,	Perley Brook,	Gardner,	5,000
John L. Sweeney,	Bailey Brook,	Templeton,	5,000
L. G. McKnight,	Cole Meadow Brook,	Gardner,	5,000
F. J. Pierce,	Foster Brook,	Gardner,	5,000
Homer R. King,	Tatnuck Brook,	Worcester,	10,000
Homer R. King,	Fessenden Brook,	Paxton,	5,000
Geo. L. Gill,	Carpenter Brook,	Northbridge,	5,000
Arthur F. Randles,	Northbridge Brook,	Northbridge,	5,000
Arthur F. Whitin,	Prentiss Brook,	Northbridge,	5,000
H. W. Rogers,	Mill Brook,	Upton,	5,000
Edward E. Whiting,	Mechanics Street Brook,	Upton,	5,000
Patrick Shaughnessy,	Pudding Street Brook,	Upton,	5,000
Jos. P. Love,	Potash Brook,	Dudley,	10,000
E. H. Vaughn,	Sugar Brook,	Prescott,	10,000

Sutton Hatchery — Concluded.

APPLICANT.	Name of Waters.	Town.	Number.
N. W. Packard,	Bell Brook,	Oakham,	10,000
W. N. Boylston,	Station Brook,	Princeton,	10,000
Samuel E. Hull,	Purgatory Brook,	Sutton,	10,000
Charles L. Allen,	Barber Brook,	Worcester,	10,000
John G. Hagberg,	Reidl's Brook,	Worcester,	10,000
Clarence C. Wood,	Sudbury River,	Hopkinton,	10,000
J. D. Stewart,	Indian Brook,	Hopkinton,	10,000
John B. Ripley,	Blandford Brook,	Chester,	10,000
Geo. H. Hapgood,	Abbott Brook,	Chester,	10,000
A. W. Hitchcock,	Sandy Mill Brook,	Westfield,	5,000
C. A. Pierce,	Hundred Acre Brook,	Westfield,	5,000
J. B. Hazelton,	Great Brook,	Westfield,	5,000
L. H. Bowers,	Noble Brook,	Westfield,	5,000
Robert L. Soper,	Kellogg's Brook,	Westfield,	5,000
H. T. Snow,	Powder Mill Brook,	Westfield,	5,000
Chas. N. Lewis,	James Brook,	Westfield,	5,000
E. G. Clark,	Hollister Brook,	Westfield,	5,000
F. F. Shephard,	Timber Swamp Brook,	Westfield,	5,000
E. B. Crane,	White Brook,	Westfield,	5,000
Alfred Read,	Cold Spring Brook,	Westfield,	5,000
John M. Santer,	Oak Orchard Brook,	Westfield,	5,000
Robert L. Parks,	Black's Brook,	Russell,	10,000

Hadley Hatchery.

J. W. Hill,	Mill River Brook,	Williamsburg,	5,000
A. M. Lyman,	Creamery Brook,	Montague,	5,000
Geo. A. Elder,	Roaring Brook,	Whately,	5,000
Geo. A. Elder,	Potash Brook,	Whately,	5,000
M. E. Fitzgerald,	Swamp Brook,	South Hadley,	5,000
B. C. Brainard,	Castleborough Brook,	South Hadley,	5,000
Geo. Hofmann,	Stony Brook,	South Hadley,	5,000
Peter Welcker,	Leaping Well Brook,	South Hadley,	5,000
Thos. F. Buckley,	Elmer's Brook,	South Hadley,	5,000
A. H. Hoadley,	Bachelor's Brook,	South Hadley,	5,000
F. E. White,	Bachelor's Brook,	South Hadley,	5,000
A. D. Cooke,	Goepel Brook,	South Hadley,	5,000
R. W. Aldrich,	Buffum Brook,	Pelham,	5,000
E. P. Bartlett,	Amethyst Brook,	Pelham,	5,000
J. R. Anderson,	Cooke Brook,	Pelham,	5,000
E. B. Dickinson,	Purgatory Brook,	Pelham,	5,000
Jas. F. Page,	Taylor Brook,	Amherst,	5,000
T. R. Hill,	Russell Brook,	Amherst,	5,000
F. E. Hawkes,	Packard Brook,	Goshen,	5,000
M. W. Smith,	Roger's Brook,	Goshen,	5,000
W. A. Smith,	Highland Brook,	Goshen,	5,000
Lewis F. Gayler,	Beaver Brook,	Northampton,	5,000
Ed. P. Felker,	Mosquito Hollow Brook,	Northampton,	5,000
Adolph Sweeney,	Turkey Hill Brook,	Westhampton,	5,000
Edward Miller,	Main Brook,	Westhampton,	5,000
Arthur Eagan,	Pomeroy's Brook,	Easthampton,	5,000
Jas. Longdon,	Parson's Brook,	Easthampton,	5,000
H. C. French,	Running Gutter Brook,	Hatfield,	5,000
Samuel Spencer,	Broad Brook,	Hatfield,	5,000
Chas R. Brewster,	West Brook,	Williamsburg,	5,000
John Martin,	Robert's Meadow Brook,	Williamsburg,	5,000

Adams Hatchery.

C. J. Russell,	Lively Brook,	Colrain,	5,000
C. J. Russell,	Hockanum Brook,	Colrain,	5,000
C. J. Russell,	Roberts Brook,	Colrain,	5,000
C. J. Russell,	Bell Brook,	Colrain,	5,000
Jas. Sanders,	Benton Brook,	Otis,	10,000
J. W. Sweet,	Machine Shop Brook,	Tyringham,	5,000
John P. Quiggley,	Roaring Brook,	Lee,	5,000
J. L. Hover,	Flat Brook,	West Stockbridge,	10,000

Adams Hatchery — Concluded.

APPLICANT.	Name of Waters.	Town.	Number.
Frank S. Clark,	Wadham's Brook,	Richmond,	10,000
F. O. Downing,	Sachem Brook,	Lanesborough,	10,000
F H. Pierce,	Pierce Brook,	Windsor,	10,000
E. H, Pierce,	White Brook,	Windsor,	5,000
W. C. Flounsburgh,	Flint Rock Brook,	Dalton,	10,000
W. M. Cooper,	Anthony Brook,	Dalton,	5,000
Wesley D. Barton,	Barton Brook,	Dalton,	5,000
Chas. W. Nims,	Fiske Brook,	Shelburne,	10,000
E. C. Hawkes,	Trout Brook,	Charlemont,	10,000
Willard E. Hoyt,	Hopper Brook,	Williamstown,	10,000
Sandborn G. Tenney,	Sweet Brook,	Williamstown,	10,000
A. A. Shipper,	Langdon Brook,	Rowe,	10,000
C. M. Pettingill,	Mitchell Brook,	Cummington,	5,000
C. M. Pettingill,	Crosby Brook,	Cummington,	5,000
C. M. Pettingill,	Shaw Brook,	Cummington,	5,000
C. M. Pettingill,	Warner Brook,	Cummington,	5,000
H. S. Packard,	Cole Brook,	Plainfield,	10,000
Geo. F. Sayles,	Tophet Brook,	Adams,	10,000
Wm. P. Martin,	Fiske and Bolton Brooks,	Adams,	10,000
A. W. Safford,	Patton Brook,	Adams,	10,000
F. H. Burr,	Ringville Brook,	Worthington,	10,000
Total trout fry distributed,			865,000

Yearling and Fingerling Plants — 1901.

Yearling Brook Trout.

Edward T. Hull,	Rattle Snake Brook,	Stockbridge,	1,000
J. H Casey,	Green Water Brook,	Lee,	1,000
H. H. Thompson,	Joyner Brook,	Egremont,	1,000
A. M. Nichols,	Sherman Brook,	North Adams,	1,000
A. M. Nichols,	Hudson Brook,	Clarksburg,	1,000
H W. Barton,	Benton and Barton Brooks,	Dalton,	1,000
George F. Ide,	Spring Brook,	Attleborough,	1,000
William W. Norbery,	Moffat Brook,	Northbridge,	500
H. A. Mower,	Lynde Brook,	Leicester,	1,000

Fingerling Brook Trout.

J. F. Mitchell,	Summit Brook,	Grafton,	250
E. A. Bridgeman,	Meadow Brook,	Grafton,	250
H. W. Rogers,	Mill Brook,	Upton,	250
E. E. Whiting,	Mechanic Street Brook,	Upton,	250
P. Shaughnessy,	Pudding Street Brook,	Upton,	250
W. C. Knowlton,	Summit Brook,	Shrewsbury,	250
F. W. Cowles,	White Brook,	West Brookfield,	500
H. F. Snow *et al.*,	Sandy Mill Brook,	Westfield,	2,700
L. C. Coburn *et al.*,	Powder Mill Brook,	Westfield,	
C. A. Pierce *et al.*,	White Brook,	Westfield,	
George Bowers *et al.*,	Great Brook,	Westfield,	
H. C. French *et al.*,	Running Gutter Brook,	Northampton,	2,700
Dana Pearson *et al.*,	Parsons Brook,	Northampton,	
Samuel Spencer *et al.*,	Broad Brook,	Northampton,	
Charles W. Nims *et al.*,	Fisk and Barton Brooks,	Greenfield,	2,700
R. C. Burrell *et al.*,	Bread and Cheese Brooks,	Westport,	1,350
Dana C. Everett,	Shingle Island Brook,	Westport,	450
Thomas Rice,	Ledge Brook,	Freetown,	450
A. W. Cummings,	Line Brook,	Assonet,	450
H. C. Hunter *et al*,	Milham Brook,	Marlborough,	2,700
E. W. Lindley *et al.*,	Flag Brook,	Marlborough,	
F W. Larabee *et al.*,	Bartlett Brook,	Marlborough,	
Charles M. Kimball *et al.*,	Houghtons Brook,	South Acton,	2,700
T. R Hill,	Hearthstone Brook,	Amherst,	2,700
H. B. Perry,	Hop Brook,	Amherst,	
L. H. Dickinson,	Montague Brook,	Amherst,	
J. F Page,	Taylor Brook,	Amherst,	
J. W. Harlow,	Swift River Brook,	Amherst,	

Fingerling Brook Trout — Concluded.

APPLICANT.	Name of Waters.	Town.	Number.
C. J. Russell,	Bill and Mountain Brooks,	Colrain,	2,700
C. J. Russell,	Spur and Foundry Brooks,	Colrain,	
F. M. Smith,	Leaping Well Brook,	South Hadley,	2,700
T. F. Buckley,	Gospel Brook,	South Hadley,	
B. C. Brainard,	Elmer Brook,	South Hadley,	
George Hofman,	Buttery Brook,	South Hadley,	
F. E. White,	McGrath Brook,	South Hadley,	
M. L. Welcker,	Stony Brook,	South Hadley,	
J. W. Jackson *et al.*,	Plaster Mill Brook,	Belchertown,	1,800
A. A. Edwards,	Waite Corner Brook,	North Brookfield,	1,800
G. S. Dickinson,	Horse Pond Brook,	North Brookfield,	
W. E. Hobbs,	Bigelow Brook,	North Brookfield,	
T. J Manly,	Lake Quacumquasit,	North Brookfield,	
Charles L. Allen,	Barber Brook,	Worcester,	900
Homer R. King,	Paxton Brook,	Paxton,	900
John G. Hagberg,	Reidl's Brook,	Worcester,	900
I. F. Williams,	Dunleary Brook,	Uxbridge,	900
Rufus B. Dodge,	Gould Brook,	Charlton,	900
G. A. Bigelow,	Cogg Brook,	Princeton,	900
A. B. Fisher,	Mill Brook,	Rutland,	450
Wm. E. Healy,	Poor Farm Brook,	Rutland,	450
H. W. Rogers,	Mill Brook,	Upton,	450
E. E. Whiting,	Mechanic Street Brook,	Upton,	450
A. S. Noyes,	Northbridge Brook,	Northbridge,	450
A. F. Randles,	Dudley Brook,	Northbridge,	450
George L. Gill,	Carpenter Brook,	Northbridge,	450
R. C. Pierce,	Barton Brook,	Dalton,	450
H. A. Barton,	Benton Brook,	Dalton,	450
D. P. Waters,	Spaulding Brook,	West Peabody,	900
F. L. Wilkins,	Alewife Brook,	Gloucester,	900
H. S. Noyes,	Water Works Brook,	Newburyport,	900
George N. Goff,	Palmers River,	Rehoboth,	900
Wm. P. Martin,	Axtell and Ballow Brooks,	Adams,	900
George F. Sayles,	Tophet Brook,	Adams,	900
Total brook trout fingerlings distributed,			44,750

The following brooks were stocked with brook trout yearlings in 1901, and closed under chapter 284, Acts of 1900: —

	Number.
Argella Brook, Groveland,	2,000
Flat Brook, Ware,	1,000

In addition to the above, the following fish have been put into ponds, mostly for stocking them in accordance with chapter 208, Acts of 1897; 2,600,000 pike perch fry, 15,000 rainbow fingerlings, 586 Loch Leven yearlings, 13,000 landlocked salmon, fingerlings and 250 four-year-old brook trout.

The total output of fish for the year, not including about 3,000 fingerlings yet to be distributed, is 3,550,086, of which 12,086 were yearling trout, and 72,750 were fingerlings.

[D.]

Distribution of Pheasants.

Pheasants were liberated in the covers in various sections of the State, as indicated in the following list, which also embraces the names of applicants for the distribution of these birds: —

Howard Marston,	Centreville.
Walter D. Bullock,	Fall River.
J. C. Shaw,	New Bedford.
H. E. Richardson,	West Brookfield.
A. D. Norcross,	Monson.
J. H. Whitcomb,	Ayer.
William Leonard,	East Foxborough.
J. B. Brown,	Ipswich.
H. E. Richardson,	Littleton.
Charles M. Kimball,	South Acton.
E. B. Stoddard,	Worcester.
F. S. Dewey,	Westfield.
E. E. Whiting,	West Upton.
Clifton R. Bridges,	North New Salem.
C. E. Childs,	North Adams.
Frank Gerrett,	Greenfield.
Alexander S. Jenney,	Weston.
Henry Riddell,	Nantucket.
I. M. Small,	Truro.
Supt. Middlesex Fells,	Melrose.
F. M. Smith,	South Hadley.
T. R. Hill,	Amherst.
J. C. Shaw,	New Bedford.
A. M. Lyman,	Montague.
C. M. Pettingill,	Cummington.
Cyrus W. Taft,	Whitinsville.
Theodore Bates,	Worcester.
William H. G. Wight,	Lowell.
Selectmen,	Orleans.
William B. Phinney,	Lynn.
Henry W. Peabody,	Salem.
Arthur Clark,	Dedham.
Joseph P. Love,	Webster.

George F. Day,	Uxbridge.
Dr. E. M. Barstow,	Wrentham.
A. D. Norcross,	Monson.
J. E. Tweedy,	North Attleborough.
Clarence P. Abbott,	Groveland.
John Kenrick,	South Orleans.
Arthur E. Newcomb,	Ware.
Frank A. Shiner,	Franklin.
J. Myron Moore,	Gardner.
Arthur E. Roberts,	Reading.
Fred S. Lufkin,	Gloucester.
H. C. French,	Northampton.
Rep. George F. Leslie,	Waltham.
Henry M. Knowles,	New Bedford.
Tobias H. Burke,	Quincy.*
Daniel A. Goodwin,	Newburyport.
James W. Sargent,	Kingston.
Alton D. Elmer,	Northfield.
J. W. Jackson,	Belchertown.
A. K. Lincoln,	Plainfield.
Selectmen,	Falmouth.
Selectmen,	Harwich.

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* The pheasants supplied on the application of Mr. Burke were liberated on the Blue Hill Reservation.

[E.]

DISTRIBUTION OF BELGIAN HARES.

Belgian hares have been liberated in the covers as indicated in the following list, in compliance with applications received from the persons whose names appear: —

Arthur E. Newcomb,	Ware.
H. C. French,	Northampton.
Arthur E. Roberts,	Reading.
E. J. S. Miller,	Concord.
Henry W. Peabody,	Monserrat.
Antonia Sylvia,	Gloucester.
Selectmen,	Harwich.
Henry G. Ford,	Marshfield.
D. W. Johnson,	Marlborough.
I. M. Small,	Truro.
Arthur L. Staples,	Greenfield.
J. E. Marvell,	West Wareham.
Arthur Clark,	Dedham.
A. E. Ward,	Woodville.
Wm. B. Phinney,	Lynn.
Arthur W. Beckford,	Danvers.
Clarence P. Abbott,	Groveland.
Charles M. Kimball,	South Acton.
Benjamin F. Smith,	Andover.
Theodore C. Bates,	Worcester.
F. M. Smith,	South Hadley.
C. C. Childs,	North Adams.
T. R. Hill,	Amherst.
Louis M. Hauff,	Rutland.
J. Myron Moore,	Gardner.

[F.]

REPORTS OF PAID DEPUTIES.

The following extracts from the annual reports of the regular salaried deputies, and from special deputies, who have served a portion of the year as paid officials, are placed together in this classification. Two of these reports are from local deputies, with restricted responsibilities, one of them being in charge of Mill Pond, at Yarmouth, which has been reserved for the use of the State, and the other having supervision of the fishway at Lowell. Both of them are charged with the enforcement of laws relating more especially to their respective charges, but neither of them has made any arrests. In one other case no arrest was made by a special deputy, although he labored zealously and effectively to promote observance of the fish and game laws.

It has been necessary, in editing these reports, to eliminate much of their subject matter, in order to bring them within the limits which will admit of their publication. Generally speaking, this has not changed the character of the information or its scope, although the statements have been made more concise. In some cases, however, it has been deemed necessary to leave out interesting statements, especially those relating to experiences met with in the enforcement of law; but, as the result of this work is summarized in the tabulated statement of arrests, convictions and penalties, the imperative necessity for condensation demanded the action taken. Such action was also required because the paid deputies have generally worked in pairs and groups, and have often had the co-operation of volunteer deputies; therefore the aggregate result must speak for the effort of all in securing it, for it is evident that space will not admit of long explanations or detailed accounts of individual experiences.

Statements by deputies Luman and Rich regarding places visited and distance travelled in the performance of their respective duties will convey some idea of the activity of the salaried officers in the enforcement of law, the distribution of fish, pheasants and Belgian hares, etc. These statements are all the more striking because each of these officers is limited in territorial range, as compared with some others whose duties take them over a large part of the State.

The work of the deputies is, as a matter of course, chiefly the enforcement of law, and often this requires the most earnest and zealous effort every day in the week, and frequently at all hours of night as well as day. But in addition to this they have been called upon to distribute fish, birds and animals; blanks to fishermen; copies of fish and game laws; to collect information of various kinds; to examine and report upon sawmills and brooks; and to attend to other matters in the interest of the public service. Rapid movement and continuous activity, as a rule, has enabled them to accomplish much for so small a force.

It has been found desirable, for reasons already given, to make no attempt to differentiate the arrests made by the paid and unpaid deputies, and each class of officials is entitled to any credit due on this account.

The total number of arrests made were 156. Of these, convictions were secured in 134 cases, and fines were imposed to the amount of $1,578.16. To this may be added $100 paid by Webster Hart for killing a deer in 1900. This was an appealed case.

It is not, however, in the amount paid in to the State as a result of convictions that a true estimate of the value of the service performed can be made; but this must be based chiefly on the almost universal testimony that comes to the commission from all sections of the State, especially from the unpaid deputies, that never before has there been such a respect shown for fish and game laws as now. That there have been violations no one will attempt to deny, but these have been so few (outside of laws relating to the lobster), compared with previous conditions, that the improvement in the observance of such laws is generally and favorably commented upon.

The appropriation for this branch of the service is mentioned elsewhere, as well as other facts relating to the enforcement of law, etc., and those statements need not be repeated here.

YARMOUTH, NOV. 22, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — I have seen no illegal fishing or gunning, therefore have made no arrests. The only work I have done outside of looking after the pond is going to Sandy Neck with Mr. Rich. . . . Fish and game in this locality, I think, are increasing. . . .

Respectfully, JAMES A. ELLIS,
Deputy.

PROVINCETOWN, NOV. 20, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . In the enforcement of the laws I have travelled 5,250 miles and visited 34 towns; have liberated 36 pheasants and 40 Belgian hares. . . . The lobster fishery is about the same as past years, and the pheasants are seen often and are doing well on the Cape.

Respectfully, S. B. RICH,
Deputy.

QUINCY, NOV. 20, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — My first work as special deputy commenced July 9, 1901. On that date Captain Rich and I went aboard the cat-boat "Cyrene," to work Boston harbor and the north shore, looking after violators of the lobster law. For reasons already known to the commission, our trip of two weeks was a failure. After that my work was mostly investigating complaints made of violations of the laws, but I found most of them unfounded. I find the lobster law being violated to a great extent by some of our fishermen all along the coast, especially in Boston harbor and on the north shore. The enforcement of the law can never be effective until the commission has under its control a suitable steam or naphtha launch for that purpose, as the violators mostly live on the islands along the coast.

There has been a fairly good catch of smelts the present season, but their protection should be more rigidly looked after in their spawning season at Weymouth Fore River, Back River, and Hingham Weir River, as they are the most important breeding places in the State.

Quail are quite plentiful; there are some partridges and very few woodcock. The insectivorous and song birds have been plentiful the present season, but their natural enemy, the Italian, has been at them this fall.

Respectfully, CHARLES N. HUNT,
Deputy.

TAUNTON, Nov. 20, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — I have been at Buzzard's Bay a number of times during the summer, and find that all the fishermen say the lobster was never so scarce as it is at present. . . . Game in this vicinity is increasing. . . . Partridge, quail and rabbits are quite plentiful.

The proximity of the Rhode Island State line makes it difficult to enforce the law here the way that I should like to. Last year I had complaints of three who were hunting for market; this year there was only one of whom I had complaint. Sunday hunting is not bad, although we can improve on present conditions. Three deer have been reported at North Taunton several times.

The sportsmen in this vicinity are very thankful to the commission for stocking Assowompsett Pond with food fish, and are living up to the law.

Respectfully, HARRY A. DICKERMAN,
Deputy.

LYNN, Nov. 23, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I have found this year a strong and growing sentiment in favor of the enforcement of laws relating to the protection of fish and game. Some of the strongest support we have has come from men who are only beginning to realize that there is a Commission on Fisheries and Game that will enforce the laws.

There is very little Sunday shooting going on about here. I have been out every Sunday, when at home, and what Sunday shooters I have found have been shooting at a target.

I have found but one line of snares this fall, and, though I watched for the owner for four days, he did not show up, and I then destroyed the snares.

Game is increasing in this district, quail especially. The Lynn Fish and Protective Association liberated twenty dozen quail last spring in good covers in Lynn, Swampscott, Salem and Peabody. The birds bred well, and the local hunters have had a good season's sport. . . .

Partridges have been quite plentiful in Saugus, Lynnfield, Danvers and Middleton. Pheasants are seen occasionally in our woods. I have reports of large numbers being seen in Danvers, Middleton and Topsfield, — a farming district, — where they seem to do well. Some of my friends who were hunting quail in Danvers one day this fall tell me they were bothered in their sport by their dogs finding pheasants. They started ten or a dozen birds. I have heard of more woodcock being seen and killed this fall than for a number of years. I think it has been a very successful season for game of all kinds.

The local fishermen have not had a very good season, owing to the dry summer, and one of our best bass ponds being drained off, while another was closed, — that is, the letting of boats on the pond was prohibited, which stopped most of the fishing.

The lobster, which I consider the most in need of protection, is being exterminated by the action of the fishermen, who take all of the small ones which they find in their traps. The enforcement of the lobster laws is very difficult, owing to the methods adopted by the fishermen to evade them, and the support given by owners of hotels at the seaside resorts. Many of the fishermen and dealers whom I have talked with on this question say the only show for the lobster is a close season.

The action of the commission in publishing in the public press the decision of the Attorney-General in regard to the enforcement of the Sunday fishing law has been commended by all fishermen.

Respectfully, THOMAS L. BURNEY,
Deputy.

LAWRENCE, Nov. 12, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — Suckers and lampreys appeared in the fishway in April. In the month of May and the first part of June there was quite a large run of lampreys. They all disappeared by the last of June. All other fish disappeared as the river lowered and the sewer poured its contents into the pool at the foot of the fishway. Three salmon were seen in the river back of the Farwell bleachery, but no salmon were seen in the fishway or in the pools at the foot of the dam when the river was low, as has often been the case in former years.*

Respectfully, THOMAS S. HOLMES,
Deputy.

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* Writing under date of July 17, Deputy Holmes makes the following statement regarding salmon: "I hear that some salmon were seen in the Shawsheen River, a little way above where it enters the Merrimac, and four were seen back of the Farwell bleachery (about a quarter of a mile below the dam), but I have seen none in the fishway or at the foot of the dam." He also remarks that "with the sewer emptying into the pool where the water runs out of the fishway, I do not think any salmon would enter there." In a supplementary letter written after his report was submitted, he says: "The city of Lawrence has finally cleared out the channel to the sewer, so it runs down the river instead of back to the dam. . . . Now if the fishway was improved a little at the lower end, we might expect a run of fish next year." The sewer referred to has for some time past discharged its contents into the river at or near the foot of the fishway, and the sewerage has polluted the water to such an extent that few fish could approach the fishway. As a result, the utility of the fishway has been much impaired, and fish life has been injured, because migratory species, which come into the river from the pure waters of the ocean to spawn, could not pass through the polluted water at or below the fishway to reach their spawning grounds higher up the stream.

SPENCER, Nov. 10, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — I have enforced the law in this and other sections of the State where I have been sent to the best of my ability. . . . I have endeavored to use every one with fairness, and shall continue to do so. At the same time, I shall enforce the law fearlessly, with special favors to none. I am satisfied that the commissioners, with the small number of deputies they have, cannot enforce the law as strictly as may be necessary to protect fish and game. . . .

This has been a good year for trout, owing to the high water throughout the season. Partridges are more plentiful this fall than they were last. . . . Quail were never so plenty in Worcester County as they are now.

Respectfully, A. D. PUTNAM,
Deputy.

PALMER, Nov. 20, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . Since my appointment in May I have . . . done my best to look after the fish and game interests in this section of the State. . . . I have visited forty cities and towns in the State on official business. I have assisted other deputies, and have stocked various waters with food fish, trout and fry, besides liberating Mongolian pheasants. The cities and towns I have visited during the year are as follows: Springfield, Holyoke, Westfield, Worcester, Quincy, Ludlow, Granby, Wilbraham, Monterey, Spencer, Ware, Gilbertville, Hardwick, Monson, Hampden, Granville, Shelburne Falls, Enfield, Greenwich, Brimfield, North Andover, Southwick, Wales, West Brimfield, North, East and West Brookfield, Belchertown, Amherst, Hadley, Northampton, Hatfield, Millbury, Warren, West Warren, West Granville, Granville Centre, Oakham, Coldbrook, New Braintree, Barre and Barre Plains.*

Trout fishing in this section the past year has been very good, and some fine catches were made from local streams. The six-inch trout law has caused some dissatisfaction with persons who fish for numbers rather than size. . . . The law is well observed by true sportsmen, who are well pleased with its enactment. . . .

Deer have been more numerous this year than ever. There is scarcely a locality which I have visited where deer have not been seen. In Granby one woman drove a fine doe into the barn-yard with her cattle.

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* Comparatively speaking, Mr. Luman's field of work may be considered local; but the simple statement of fact he has made concerning towns and cities visited will serve to show the scope of work devolving upon the paid deputies, and the activity necessary to enforce the fish and game laws, etc. — COMMISSIONERS.

The past year has been a record breaker for birds and game, and the opening day showed the result of the recent law, prohibiting the sale of birds. Quail and partridge predominate, and from every quarter comes the report that never has there been so many birds as this fall. This fact all attribute to the strict enforcement of law, and to the present law which prohibits the sale of birds. . . . Very little snaring of birds is reported in this section, and what is being done is carried on by persons upon their own land. Sunday hunting has been put a stop to, and in my section, so far as I am aware, very little, if any, is being done.

The stocking of Forest Lake and Round Pond, in Palmer, has been greatly appreciated.

I am pleased to report that the Mongolian pheasants liberated in Monson are doing well. One was killed by a small boy, who did not know what it was.

Regarding the enforcement of the six-inch trout law, in order to have it effective, the deputy should be given the power to search without warrant any basket, bag or other receptacle where fish may be placed, kept or carried.

I can truthfully say that persons are getting better accustomed to the observance of the fish and game laws, and all seem willing to be governed thereby.

Respectfully, JOHN F. LUMAN,
Deputy.

WARE, NOV. 19, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . There certainly has been a better feeling toward the protection of game and fish than formerly. The people seem to have awakened to the fact that reckless and continual hunting and fishing has only exterminated the supply of both fish and game, and old hunters think the restrictions are all right, and the laws should be enforced. In warning people not to break the law, I have generally found them willing to comply . . . and I have not discovered any serious violations. . . . On the whole, I think there has been a great improvement, and the commission is doing not only a good work, but one that is appreciated by the public.

I have found partridge plentiful, and there is also a goodly number of quail and woodcock. I have seen at least a dozen deer, and some in the near sight of the village.

Trout remain as scarce as ever, and more stocking will have to be done to make this "speckled beauty" plentiful in our streams or ponds. . . .

Gray squirrels and rabbits are quite plentiful, and seem to be increasing now that they are being protected. I am sure the general public favor the present laws, and that good is resulting from their enforcement.

Respectfully, DENNIS SHEA,
Deputy.

AMHERST, Nov. 20, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I think the fishermen respected the law in regard to short trout. Several brooks have been stocked with trout. . . .

Partridges and squirrels have been plenty. Quail were quite plenty early, but soon disappeared. . . .

I have been in the woods every Sunday except stormy days since the hunting season opened. There has been a great falling off in that kind of sport in the last two years. I find almost all the farmers and members of the Rod and Gun Club are ready to aid me in stopping Sunday hunting.

Respectfully, DAVID H. TILLSON,
Deputy.

SOUTH HADLEY, Nov. 30, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I feel satisfied that sportsmen are very careful about coming this way for any illegal hunting and fishing, and am sure the Sunday violations are very few, compared with a few years ago.

Respectfully, F. W. BROCKWAY,
Deputy.

PITTSFIELD, Nov. 15, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . The trout season opened with a very fair showing; also the bird season. There are still a great many partridges, but they are high in the hills. I came across one lot of three pheasants, — the only ones I have seen. We have also quite a few deer, and there are signs of foxes among our birds.

I have been all through the county, and have found very few snares, not more than sixty or seventy in all; and have received very few reports of snaring, which proves that our work is doing some good.

I have not found any one selling birds, but think some sales have been made.

There has been some Sunday shooting, but farmers say it is nothing compared with other years, and they are much pleased with the result of the work as carried on by your Board. . . .

Respectfully, BENJAMIN F. SMITH,
Deputy.

NORTH ADAMS, Nov. 20, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . The trout season in this section of the State has been very good. None of the streams that were stocked last spring have been dry. The sportsmen throughout this section of the State would like to have the sale of trout stopped, the same as game.

Squirrels have been very plenty, and the reports are that there will be a good rabbit season. Partridges have been plenty, and sportsmen report that there have never been so many quail and woodcock as there have been in the south-western part of the State. I have seen but two snares this season, and I think that snaring is a thing of the past in this part of the State. As to the sale of game, I have not heard of a complaint or a violation this season. The pheasants and hares that I released last spring have been seen in a number of places.

There were never so many deer as there have been this year. April 1 a deer was found dead near a brook at South Williamstown. It had been dead some weeks when found; a mark on its neck looked as though it had been shot. April 18 one was found dead by berry pickers on North Mountain, near North Adams. There were no marks on it to indicate that it had not died a natural death. One was chased by a dog into the yard of Mr. Ingalls of Heath, on October 17, and died. . . . During the ten days open deer season in Vermont I kept watch along the line, but heard of no violations on this side.

There is very little hunting on Sunday in this section. We are so near the line that when Sunday hunters start out they generally go into Vermont.

Respectfully, A. M. NICHOLS,
Deputy.

LENOX, Nov. 14, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — My duties as deputy since June 20 have been in this and adjoining towns. I find here some of the best covers for game there are in New England, but the pot hunter has got in his work, and up to last spring game was very scarce. The law prohibiting the sale of partridge and woodcock has worked wonders in this section. It is responsible for saving the remnants of the partridge, and putting the violator of the game laws out of business. When the season opened here there was good shooting, . . . and there will be plenty of birds left for seed.

As to the conditions of fish, trout are few, but bass and pickerel fishing has been excellent. . . .

Members of the Lenox Fish and Game Protective Association tell me the fish and game laws have been better observed this year than ever before.

Respectfully,
OTIS THAYER,
Deputy.

[G.]

Reports of Unpaid Deputies.

The extracts from the annual reports of unpaid deputies, which are published herewith, will indicate what has been accomplished by this widely distributed force, by advice, etc., to secure a better observance of the fish and game laws. The specially noticeable feature of these reports is the almost complete unanimity of statement that the laws have been better observed than ever before. Considering the opportunities these officers have for observation, and the interest they feel in promoting an observance of the laws for the protection of fish and game, the statements they make are important and encouraging. They indicate the possibility of securing a respect for such laws in this State, and a recognition of their value to the public, that will place Massachusetts in an advanced position in these regards.

These reports, read in conjunction with those of the paid deputies, give a rather comprehensive review of the condition of fish and game throughout the State. On the whole, the record is gratifying. The consensus of statement is to the effect that there has been an increase of the most desirable game species, notably the partridge and quail, although a few claim the former is still very scarce. There is almost universal testimony to the increase and presence of deer, likewise of pheasants.

When it is stated that only 16 of these officers out of 120 made arrests (these for the most part co-operating with paid deputies), that the average moiety of fines received by them was scarcely sufficient to pay the fee for qualification as officers (not to speak of other expenses incurred), and that most of them devoted a considerable percentage of their time to securing a respect for law, it is not difficult to recognize in their efforts a devotion to the public welfare and examples of unselfishness as rare as they are satisfactory. It is only necessary to read some of the reports to appreciate this.

The large number of reports of this kind has compelled the elimination of all but the most salient points, and those have been made as concise as possible. In a very few instances rather full extracts are published, but these are exceptional. In some cases more than one report appears from the same town, for the reason that the extracts published present some differing phases of fact, or are written by persons more or less widely separated and having diversified opportunities of action and observation, though residing within the same town or city.

In view of all that has been said regarding the avarice and selfishness of this class of officials, it is of public interest to note that there is no foundation for such a claim, as this force is now organized. This is so clearly apparent in the reports that it is beyond argument. A deputy who will spend days and days tramping through covers, watching ponds and distributing copies of fish and game laws, only to warn and advise, or who will refuse to accept his moiety of fine because such action may add a slight expense to his town, certainly cannot be accused of selfishness, whatever else may be said.

The repressive and beneficial influences of this service cannot, nevertheless, be successfully denied. This was shown in connection with the Sunday fishing law. In many places no Sunday fishing was done until it became necessary to desist from the enforcement of the law prohibiting it; but immediately after it was known that the law would not be enforced by the deputy commissioners, fishermen flocked to the ponds, streams, etc., despite the fact that the law was still on the statute books, and local officers had full authority to enforce it.

(1) *Eastern Section of the State.*

NANTUCKET, NOV. 12, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . Mackerel were plentiful. Bluefish were more numerous this summer than last, and codfish are quite abundant in deep water, but the shore fishermen are complaining that there are no codfish on the shoal grounds.

Lobsters were so scarce that I did not go into the business at all, and will never again try the lobster fishery until there has been a change for the better protection of the lobster. If lobsters are still fished for another season, I hope there will be a paid deputy appointed that will make a strict business of hunting around and enforcing the laws. . . .

I have had no violation of the fish and game laws reported to me, and so have made no arrests. . . .

Respectfully, EDWARD F. SNOW,
Deputy.

COTTAGE CITY, Oct. 31, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I have made no arrests during the past year. . . . I have watched the coast for seiners, but have not seen any, nor have I had any complaints of violation of fish and game laws. . . .

Quail are very plenty and partridge are increasing. . . .

Respectfully, E. B. ANDRUS,
Deputy.

VINEYARD HAVEN, Nov. 20, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I have known of but one violation of the game laws. Evidence was given me of a party shooting a pheasant. I immediately secured a warrant, found the guilty party, and, without trial, he pleaded guilty and paid the full fine and court charges. The bird was shot in the town of Chilmark, in Dukes County. I am pleased to state a farmer made the complaint, the bird having been shot upon his premises. I make this note for the reason that some of our farmers are not favorably inclined towards the pheasants.

Quails are reported more numerous than a year ago; with a favorable winter, we should have a great many next season. The pheasants are doing well. I believe the long open season on rabbits is detrimental to all our game. Game birds are shot by parties in pursuit of rabbits. I should be glad to see the season for rabbits close February 1. I commend this to your consideration.

As far as I know, the fine referred to above is the first one ever paid on this island for killing a pheasant, and I trust the example will be a warning to all persons who do not respect the game laws.

Respectfully, JOHN E. HOWLAND,
Deputy.

WEST TISBURY, Nov. 18, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — I have made no arrests this year. I have carefully investigated several cases, in one instance going so far as to get out a warrant, but found Deputy Howland had also been notified and had served one. There is a steady increase of pheasants, quail and partridge in this vicinity.

Respectfully, JAMES LOOK,
Deputy.

CHILTONVILLE, Nov. 22, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I have caused no arrests for violation of game laws; have not known of any in this vicinity or elsewhere. . . . I think the laws are respected by all, with possibly a few exceptions.

I am out to Long Pond every day except Sunday. . . . Going out last week one morning I saw two flocks of quail, and a cock and hen pheasant by the roadside. About ten days ago I saw a deer near Little Long Pond. There are quite a number in this section. . . .

Respectfully, ELKANNAH FINNEY,
Deputy.

CATAUMET, Nov. 22, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — I have posted in conspicuous places the cloth posters sent me, and have also distributed to hunters the laws which I received. . . . I have had no complaints of law breaking. Fishing has been very good the last season.

Respectfully, GEORGE W. ROBINSON,
Deputy.

SOUTH SANDWICH, MASS., Nov. 22, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I have made no arrests. I do not think there has been any seining done in this vicinity, but am on the watch for it. I have reason to believe that the Mashpee people have been hunting deer, but I have been unable to catch them yet. Except in this particular, I think the laws are being observed at present.

Partridge and quail are increasing in this section. Deer are probably increasing, although it has been so dry that I have not tracked as many as usual on the roads.

Black bass are plenty in Wakeby Lake. There have not been as many pickerel caught as last fall, owing probably to the seining last spring.

Respectfully, JOHN PERCIVAL,
Deputy.

MARSHFIELD HILLS, Nov. 22, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I have not heard a gun on Sunday since the three deputies were down here, for the gunners found we meant business. Partridges are quite plenty, more than has been for a long time, and the quail are very plenty this fall. Fish are about the same.

Respectfully, THOMAS STACKHOUSE,
Deputy.

COHASSET, Nov. 25, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . Quail are not plentiful, still there are some; partridge are about the same; there are plenty of wild ducks and some geese; rabbits are also quite plentiful. There are some foxes and coons. Regarding fish, there are none here which the law forbids taking. . . .

Respectfully, M. WM. SILVIA,
Deputy.

COHASSET, Nov. 24, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — I have had no occasion to arrest any person for violating the fish and game laws. . . . I have had the fishways at Dick's Mill Pond put in a condition for the alewives to pass over the dam next spring.

Last spring I procured from the Massachusetts Protective Association six pairs of quail, which I liberated here, and which have done well. . . . The partridge in this vicinity were few, but there has been an increase in their number since the new law, and I think if the law could remain as it is now for a number of years, they would be quite plentiful. . . .

Respectfully, W. O. SOUTHER, Jr.,
Deputy.

HINGHAM, Nov. 26, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . During March and April there was no patrol on the rivers by local officers, as the town did not appropriate any money. I spent several nights, and saw no one. . . . The run of smelts was about the same as last year, although the catches have not been as large. Smelt as a rule run small, in comparison with other years.

Quail and partridge were quite numerous this fall. The Italians have bothered some. I got a party of three with guns and dogs after quail. I let them go, with the promise of keeping out of the woods Sundays.

Respectfully, W. I. James,
Deputy.

Weymouth Heights, Nov. 25, 1901.

To the Commissioners on Inland Fisheries and Game.

Gentlemen: — . . . I do not find quail and partridge so plentiful as last year. I have made no arrests. . . .

Respectfully, B. F. Richards,
Deputy.

Braintree, Nov. 1, 1901.

To the Commissioners on Inland Fisheries and Game.

Gentlemen: — . . . The prevention of Sunday shooting and the enforcement of the lobster laws has occupied my attention. The town of Braintree, in which I live, is now free of Sunday hunters, and in consequence one day has been provided in which it is safe for a citizen and his family to enjoy the woods and fields.

The proximity of that town to the Blue Hills Reservation renders it a natural locality for all birds which inhabit the reservation, and they are becoming more plentiful each season. I have made no arrests, believing that a proper statement of conditions, followed by a word of warning, accomplishes fully as much, and has in addition the effect of educating would-be destroyers to a full realization of the advantages of larger quantities of birds and animals.

I believe that the lobster law should be changed so as to put a close season on them for a number of years, and I believe that the majority of the fishermen will agree that that is the only way to prevent extermination. . . .

Respectfully, Robert E. Belcher,
Deputy.

Pembroke, Nov. 18, 1901.

To the Commissioners on Inland Fisheries and Game.

Gentlemen: — . . . There has been good fishing all through the open season, the best for many years. Through closing the ponds in the ice season the anglers have had the best season they have ever had, and lots of good fish have been taken.

Game has been very plenty. Quail are very plenty, but lots of them are not full grown yet. . . . Rabbits are plenty, and the gunners are having a good time. I have not arrested any one, as I have had no occasion to do so.

Respectfully, OTIS FOSTER,
Deputy.

WEST BRIDGEWATER, NOV. 23, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — It has not been necessary for me to make any arrests, and I have not heard of any violation of the game laws.

Quail and gray squirrels seem to be numerous, but there are very few partridges. There are the usual number of song birds. Pickerel and white perch seem to abound. There have been deer seen in Raynham, about five miles from here.

Respectfully, D. R. SIMMONS,
Deputy.

NORTH RAYNHAM, NOV. 20, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I have made no arrests. I have had but one occasion; that was for hunting on Sunday. Then the parties escaped. . . . I believe the game law, as a rule, is seldom violated in this section.

Game is more plentiful, I think, than it was fifteen years ago. Fish are not as plenty in this vicinity. There is no pond nearer than Middleborough that is stocked. With our five beautiful lakes within five miles of my house, not one is closed, but are fished day and night.*

Respectfully, HENRY S. WILBUR,
Deputy.

NEEDHAM, NOV. 14, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — There has been a decided improvement in the observance of the fish and game laws during the past year. Partridge are getting very scarce in this section, while quail are on the increase, there being more here this year than for several years past. . . . I have warned two different parties, but have not had occasion to make any arrests.

Respectfully, GEORGE H. HASSAM,
Deputy.

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* The presumption is that Mr. Wilbur alludes to the ponds in Lakeville. If so, four of the largest have been closed to winter fishing, after having been stocked.

NEEDHAM, Nov. 21, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . There has been no Sunday hunting here. Quail are quite plenty. Partridge are very scarce. I have made no arrests.

Respectfully, W. H. COOK,
Deputy.

NEEDHAM, Nov. 21, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I have made no arrests, and know of no one who has been violating the law. Quail are plentiful in this section. Partridges and rabbits are fairly plentiful. . . .

Respectfully, AUGUSTUS CROWELL,
Deputy.

FRANKLIN, Nov. 22, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I had some talk with the farmers the other Sunday, and they said that it was never so still before as it had been this fall from Sunday shooting, and asked me what made it. I found one man fishing out in a boat. I got another boat and went after him, took him ashore and sent him home, and have seen no Sunday fishing since.

I have posted the game laws sent me in different places around in the woods where they would be seen. . . .

Partridges, quail and woodcock are very plenty in this section this year, and that is the reason that the Rhode Island hunters like to come over here to hunt, as they can sell them when they get home. I think we should have a law so that a deputy could search a person. The way the law is now, a man can go into Rhode Island with his hunting coat full of game, and I have no right to stop him and search his coat. The hunters in Franklin respect the law this year better than I ever knew them to before. . . .

Respectfully, H. A. BENT,
Deputy.

BOSTON, Nov. 23, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . My duties are confined mainly to keeping a strict watch over the dealers in our markets, and to the direction of the work done by two officers who are employed and paid by the Rod and Gun Club of Boston, of which I have the honor to be president. In my work around the markets I am constantly being consulted as to changes in fish and game laws, and also as to the correct interpretation of them. I also distribute many copies of said laws each year. Personally, I have had no occasion to make any prosecutions during the past year. Our deputies make their own reports to the Board. During the past thirty-five years I have taken an active part in formulating and helping to enforce our fish and game laws. I believe that our fish and game dealers as a whole are most strictly living up to the requirements of said laws.

Concerning the need of certain changes in the laws, by which the sale of woodcock and ruffed grouse was forbidden, I can say that this measure was adopted none too soon. Those birds are exceedingly scarce throughout New England, particularly the grouse. In my work I have corresponded with sportsmen in various sections, and have personally investigated in others; and the result is invariably the same in all directions, — very few grouse to be found.

Respectfully, JOHN FOTTLER, Jr.,
Deputy.

BOSTON, Dec. 9, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . During the past season we have visited all parts of the State. Last spring the brooks were very high, and in April very little trout fishing was done, and nothing illegal was noticed by us worth reporting. We have found very few cases of snaring of partridges this season. In fact, the old snarers who used formerly to make a business of it every fall have practically done nothing. . . . We have devoted considerable time to investigating complaints of gangs of Italians who have been shooting all kind of song birds in the vicinity of Boston. We have sent home a good many who claimed not to know the laws. . . .

Quail and ruffed grouse bred well this year, and have increased in numbers in most parts of the State.

Respectfully, W. E. QUIGGLE,
PAUL DILLINGHAM,
Deputies.

WAKEFIELD, Nov. 11, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . Game conditions around Wakefield are favorable this fall. Being so near Boston, the covers here are shot over a great deal; but partridges are at least holding their own, and quail are on the increase. The good effect of the prohibition of the sale of partridges cannot be stated too strongly. . . . The protective laws are well observed in this vicinity, and there is almost no Sunday shooting. I have spent all the time that I could spare in the woods, while Mr. Samuel Parker, the other deputy here, has taken good care of our lakes and streams, and neither of us has found a case of law breaking that warranted a prosecution. . . .

I respectfully submit, however, that there is need of a law to give the commission the power to close ponds to ice fishing. The only closing that can be had now is for a single period of three years; and while the acceptance by a town of chapter 331, Acts of 1888, restricting the taking of pickerel to one hand line, is partially effective to regulate ice fishing, still, the act is easily evaded, and conviction under it would be difficult. The laws of New Hampshire allow the commission to close ponds on petition of a certain number of inhabitants of the town in which the pond is located; and it seems that the Legislature ought to give our commission a like power here, for the results of winter fishing are more harmful in this State than in New Hampshire, on account of the larger number that fish here, and of the greater accessibility of our ponds.

The value of the deputy system has been shown very clearly this summer in the matter of Sunday fishing. As long as it was thought that the deputies would enforce the law against Sunday fishing, there was absolutely no fishing in the lakes here on that day; but as soon as it became known that the deputies would not enforce that law, people began to fish on Sunday. The amount of fishing was not large, it is true, but the incident showed conclusively the usefulness of the deputy system in preventing law breaking. . . .

Respectfully, GEORGE M. POLAND,
Deputy.

WAKEFIELD, Nov. 1, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — I have made no arrests this year, and have received no complaints. The lakes in Wakefield have been carefully watched. Fishing has greatly improved in these lakes during the current year, and there have been more black bass ranging in size from one to five pounds than for a number of years past. Perch are large and more plentiful; only a few white perch were caught. A great many pickerel have been caught, but they run small. Many large ones were caught last winter, ranging from one to five pounds, and this hurt the summer fishing. . . . A number of German carp weighing from ten to twenty pounds were caught in May. . . .

There has been a great increase of game the last year, and there are more partridges, quail, gray squirrels and rabbits than for a number of years past, and also more robins than last year. I think the laws have been respected, as a rule. . . .

Respectfully, **Samuel Parker,**
Deputy.

Reading, Nov. 11, 1901.

To the Commissioners on Inland Fisheries and Game.

Gentlemen: — . . . Snaring of ruffed grouse in this section is practically at an end. We have patrolled this section from end to end without finding any snares. One case has been reported which we shall investigate. The men in this section who used to shoot and snare for market are doing practically nothing in this line. . . .

Game is more plentiful this year than for several years. We have seen two pheasants, and others have been reported as having been seen in our town. Quail are very plentiful, and if we have a mild winter we may look for good quail shooting next year. Ruffed grouse are fairly plentiful, also rabbit and gray squirrel. Two deer have been seen in this section the first of this summer, one in Reading and one in North Reading. . . .

Respectfully, **Chester B. Pratt,**
Melvin H. Lowd,
Deputies.

Woburn, Nov. 7, 1901.

To the Commissioners on Inland Fisheries and Game.

Gentlemen: — . . . Since the closing of Horn Pond, except on stated days, no one has overstepped the regulations, to my knowledge. The people of Woburn seem to appreciate your efforts in this regard, and those interested are fully aware of the great drain which has taken place for many years. . . . As no one to my knowledge has transgressed the law, no arrests have been necessary. . . .

Respectfully, **Fred. J. Brown,**
Deputy.

Burlington, Nov. 16, 1901.

To the Commissioners on Inland Fisheries and Game.

Gentlemen: — . . . I have made no arrests, and have had little trouble to keep the laws enforced. Gunners have been scarce this season, and those who do go are strangers. The local residents appear to respect the laws.

There are some partridge and quail, and a number of gray squirrels. Rabbits do not appear to be very plenty. I have been out since the snow, and failed to track any. I have a flock of quail near my house, and drove so close to them to-day that I stopped the horse in the road, and could have touched them with my whip. When I stopped, they flew, as I expected.

I liberated fifteen Belgian hares about the middle of July, and have found all but three dead. All that I found had a large worm under the skin which seemed to eat the flesh. . . . I have two in the woods that stay in a lot of scrub oaks, and appear to do well. There is a common rabbit, or cotton-tail, that stays with them, and I hope it may cross with them by spring. I have ten more in yards outdoors, and they are all healthy, but too small to let out until spring. From my experience, it will be some time before they become plentiful. If I knew the cause of this worm, I would try to remedy it. Some tell me it is high feeding, but it cannot be that, for I did not feed them, while those penned up that I did feed had no worms. A friend of mine thought it was a bot, or something like it, caused by a sting from some fly. I have seen this same worm in wild rabbits fifteen years ago on Cape Cod. They are about an inch long and half an inch through, brown in color, and have what appears to be an eye; almost looks like an extra eye when seen on a rabbit.*

Respectfully, HARRY L. HASKELL,
Deputy.

NORTHBOROUGH, Nov. 22, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I have put in much time to suppress illegal fishing and hunting. I have found no one hunting Sundays, and have made no arrests. . . .

Partridge were quite plentiful the first part of the season. At the present time it is almost impossible to start one.†

There never has been as many quail as at the present time.

Respectfully, ETHAN BOTHWELL,
Deputy.

HUDSON, Nov. 20, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I have made no arrests. . . . I have heard some complaint from honest sportsmen of certain hunters using ferrets, but have never been able to prove such complaints. I found one man in the woods one Sunday with his dog, but he had no game or ferret. . . .

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* The "worm" mentioned by Deputy Haskell is probably the larval form of a fly (*Cuterebra*), which is found in several species of wild rabbits, if not in all. Rabbits are also frequently troubled with the larval form of a tape worm (*Tænia*), but neither of these appear to be detrimental to these animals for food purposes at those seasons — the colder portions of the year — when rabbits are supposed to be best for the table.

† The apparent scarcity of partridge in early November was probably due to foliage on the trees. In several sections of the State, where it was thought birds were rather scarce than otherwise, many were observed after defoliation of the trees, caused by heavy frosts and winds.

Respectfully, **Daniel D. Rose,**
Deputy.

South Acton, Nov. 16, 1901.

To the Commissioners on Inland Fisheries and Game.

Gentlemen: — . . . I have made no arrests, but have written three letters to parties said to have been violating the fish and game laws. . . . I have caused a notice to be inserted in the local paper, which I feel satisfied has greatly reduced the violations of these laws in this section. . . .

Respectfully, **L. E. Reed,**
Deputy.

Lancaster, Nov. 20, 1901.

To the Commissioners on Inland Fisheries and Game.

Gentlemen: — . . . No report of violation of the fish and game laws has been made to me this year. Game is as plenty as usual. Rabbits, woodcock, quail and gray squirrels are plenty, with not a few deer. . . .

Respectfully, **Andrew J. Kennedy,**
Deputy.

Lowell, Nov. 16, 1901.

To the Commissioners on Inland Fisheries and Game.

Gentlemen: — . . . I have visited a number of ponds in this section the past summer, and found the fishing good. Nagog Lake, in particular, in North Acton, twelve miles from Lowell, is well stocked with big-mouth bass; pickerel and yellow perch are also plentiful. I also visited Long-Sought-for Pond, at Westford, where I found good fishing, especially for yellow perch, some of which weigh two pounds each. Fishing has been good all summer at Great Pond, in Andover. Parties have gone there from Lowell this summer and got some very nice catches of bass and white perch. The bass taken there are the small-mouth species. . . . Fishing at Great Pond is better, I suppose, because of the restrictions. . . . I can truly say that the fish are increasing in the ponds in this vicinity. . . .

Game is very plentiful this year in this locality. There are lots of hares, partridge, gray squirrels and quail. A while ago people this way were afraid the game had all or nearly all left this part of the country, but I am happy to say such is not the fact. . . . Last

Tuesday one man went to Carlisle and brought back six nice gray squirrels, four quail and one woodcock. . . .

A deer was found dead at Middlesex; he was killed by a fall. He was found by a Mr. McDonald at the foot of a high embankment, with no bullet wounds. . . .

Respectfully, CHARLES W. SWAN,
Deputy.

LOWELL, Nov. 19, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . A new fishway is badly needed here. . . . During the month of May there were a great many eels here at the fishway, but not as many as last year. A large number of chub, suckers, yellow perch and hornpouts have also been seen around the fishway. I likewise saw a lot of small-mouth and large-mouth black bass, and have seen eight salmon in the pools near the fishway. The fishing in the vicinity of Lowell has been good this year; some splendid strings of pickerel and large-mouth bass have been taken from Great Pond, North Andover, Concord River, and Lake Nagog, in North Acton. The white perch that were put in Leach's Pond three years ago, I think, are doing well; schools of them have been seen near the surface after sundown on several occasions. Nabnasset Pond and also Long Pond, which were stocked in 1897, are now open to ice fishing, after having been closed during the last three years, and the fishermen expect some good fishing in them. . . . I have made no arrests.

Partridge and woodcock are rather scarce. Quite a number of quail have been seen, but mostly young birds. Gray squirrels and rabbits are more abundant than last year. A number of deer have been seen in the vicinity of Lowell. I know where there are five within six miles from here. I investigated the killing of a deer on November 13, and was very glad to find that the animal was not shot, but was killed by jumping from a high crossing near Middlesex village.

Respectfully, GEORGE T. SPENCE,
Deputy.

DRACUT, Nov. 25, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . Partridge are on the increase. By careful observation I am satisfied that the new law and shortening of the season are doing a lot of good. . . . Quail are more plentiful than I have seen them for years, but small, — hardly larger than robins.

There seems to be a second brood of birds in the fields. Quail also show the good the law against market shooting has done. Woodcock I can say but little about, for I have been able to raise only two birds all the fall. There are a few deer, and they are slowly increasing. I have seen two does with fawns this fall. . . . One four-year-old buck came to the city two weeks ago, and while crossing a bridge over a railroad was frightened, and jumped over the side to the railroad below and was killed.

White perch in Long Pond are beginning to show up, also black bass now and again. . . . Rabbits are plenty this year, and game wardens have had their hands full watching men with ferrets, who have given them lots of bother, but have been very successful in keeping them where they belong. I think a person caught in the act of using a ferret, in addition to the regular fine, should forfeit dog, ferret, and everything used for getting the rabbit.

Respectfully, C. FRANK SCOTT,
Deputy.

DUNSTABLE, NOV. 28, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — I have visited Massapoag Pond seventy-three times during the season; have made no arrests. A cold, backward spring prevented much fishing and camping out which has been practised in former years. . . .

Squirrels, partridges and rabbits are quite plentiful. One hunter caught an old-fashioned white rabbit, the first I have seen for more than thirty-five years. Deer are quite numerous in the spring and summer months; in fact, two or three of them frequented my mowing fields day and night for the last two years, and made quite a path through my corn fields. Three, four and five have been seen in the highways at one time by several persons. My father has lived in this section for eighty-one years, and never saw anything like it before.

Respectfully, GEORGE W. CHANEY,
Deputy.

LYNNFIELD, NOV. 10, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . Partridges are about as plenty as last year; quail and woodcock are very scarce. I do not have much trouble with Sunday gunners. The pike perch have not been seen this year.

Respectfully, GEORGE WILLIAMS,
Deputy

PEABODY, Dec. 7, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN:— . . . I have heard of some shooting on the Sabbath, suspicions of parties violating the lobster law, and also parties taking smelts illegally by net; but I have been unable to locate them, as they destroyed their net after hearing that I was making investigation. I understood they were selling from twenty to thirty pounds per day, but I was unable to purchase any myself or get any one to purchase some for me. There has been very little Sunday shooting, and what there was, was in the vicinity of Cape Ann. . . .

I have seen quite a number of pheasants in the vicinity of Ipswich, Wenham and Hamilton. . . .

Respectfully, A. B. CLARK,
Deputy.

BEVERLY, Nov. 26, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN:— . . . The quail have been more plentiful in this section of the State during the last summer and fall than they have been at any time in my remembrance. . . . Pheasants have done well, and are rapidly increasing. I have seen and heard of numerous birds in the last six months. The partridges are fairly plentiful.

I have put in much time Sundays and other days when I could spare the time from my work. I have not made any arrests, but have sent several boys home who had started out to shoot on Sunday. . . .

Respectfully, EZRA S. PIERCE,
Deputy.

BEVERLY, Nov. 21, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN:— . . . Quail were never more plentiful. . . . Partridge are more numerous than last year, but not many woodcock have been bagged. Pheasants are doing fine, and on my travels I have seen many. I have received a few complaints of Sunday shooting, but have myself come across no one violating the law, and have been in the woods almost every Sunday.

The varieties of fish caught in our lakes and streams give the boys lots of sport, and are not decreasing.

Respectfully, F. G. LEFAVOUR,
Deputy.

BEVERLY, Nov. 18, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . Last spring I liberated five dozen quail, . . . and up to the first of October I do not think one had been killed. I also watched the brooks in the spring, and saw no violation of the law in regard to catching smelts. Quail have increased in the last two years, but partridge and woodcock are scarce. Black ducks are very abundant this year. The sportsmen have respected the Sunday law in every detail, therefore I have been unable to make any arrests.

Respectfully, GEORGE W. GOLDSMITH,
Deputy.

WENHAM, Nov. 20, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — The year has been a very successful one, from the fact that we have been bothered little by law breakers. . . . Game is very plentiful. Partridge and quail seem to be on the increase, while woodcock are seldom seen. Pheasants seem to be on the increase, in some sections being so plenty as to bother sportsmen who are out after quail. . . .

Respectfully, FRED S. KNOWLTON,
Deputy.

MANCHESTER, Nov. 18, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — This was a good season for pheasants; they have increased to large numbers, and we can see young flocks everywhere. They are a delight to the people in our vicinity. Quail cannot be found, except those we have liberated. Partridge and woodcock are not often seen and other game is scarce here. There has been no Sunday gunning or other violation of the law, so far as I know.

Respectfully, HERMAN THIEMANN,
Deputy.

NORTH ANDOVER, Nov. 23, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . As regards the public complying with the laws, I must say that they have fulfilled all the requirements. . . . Partridge, quail, squirrels of all kinds, and rabbits are flourishing.

Respectfully, WILLIAM J. TOOHEY,
Deputy.

IPSWICH, NOV. 18, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I have not arrested any one this year. . . . Quail and partridge I know are plenty this fall. I have seen more pheasants this year than any time, . . . and I think they are increasing in Ipswich. . . .

Respectfully, JAMES A. LORD,
Deputy.

GEORGETOWN, NOV. 18, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — I was appointed the present year, and have had only a short time in service. . . . I have spent considerable time in the woods about here, but have seen no violations of the laws, nor have I heard of any. . . . Game, especially partridges, is more plentiful than it has been for some years, and now and then a pheasant is seen in the fields between Georgetown and Groveland.

Respectfully, ELWOOD T. WILDES,
Deputy.

GROVELAND, NOV. 17, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — I have made no arrests this year. I have used all of my spare time in looking after the fish and game in the town of Groveland. The trout that were placed in Argelia, or Brown's Brook, last spring, are growing very fast; from fifteen to thirty nice trout can be seen in places. Mr. Gardner Wood and myself and other members of the Groveland Fish and Game Protective Association have fed worms and bugs to the fish as often as possible all summer. There has been no fishing in the brook since June 5 of this year. We expect people will try to fish next spring.

Most of our people are in favor of having very strict laws to protect the fish and game. Chapter 379, Acts of 1900, has been a great help in preserving game. I think the sale of quail should also be prevented. The pheasants are all alive. We leave wheat and cracked corn where they can find it. The association has obtained permission from the owners of about seven hundred acres of land to post it, and prevent gunning and trapping thereon. Quail, partridge and rabbits are plentiful. Gray squirrels and woodcock are scarce. Sunday gunning has been stopped.

Respectfully, LOUIS C. GORDON,
Deputy.

AMESBURY, Nov. 25, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — I have made no arrests, and, as far as I know, no one has broken the fish and game laws. Partridge and quail are increasing and the pot hunters are decreasing.

Respectfully, LAWRENCE FREEMAN,
Deputy.

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(2) *Central Section of the State.*

MILFORD, Nov. 6, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . Quail were very plenty at the opening of the shooting season, but the hunters have been after them early and late. It seems to me to be inconsistent to allow the sale of the very birds which the sportsmen have been planting all over the State. . . . As for partridge, I have seen quite a number, but hunters say they are scarce, and I hear of but few woodcock being shot. Pheasants are seen occasionally, and there are more about here than are seen, as they are very shy. Several deer have been seen during the spring and summer.

There have been two cases of Sunday shooting before the courts here, brought by a local officer. . . . You can form some idea of the amount of shooting done in this vicinity from the fact that one dealer in ammunition has sold over eight thousand shells, and three other dealers not heard from.

Respectfully, W. N. PRENTISS,
Deputy.

WESTBOROUGH, Dec. 1, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I have made no arrests. . . . There have been a great many more quail this year than there has been before for a number a years. . . .

Respectfully, A. H. SANDRA,
Deputy.

MILLBURY, Oct. 20, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I have enforced the close season on Dority Pond, and have completely stopped the practice of taking small bass. I have investigated many complaints, and have stopped further violations. I have not made any arrests. . . . Trout were more plentiful this year than last. They should be still more abundant next year. . . .

Deer are frequently seen, and are evidently on the increase. There are more partridge and quail than I have known for many years. The laws have been well observed. I only know of one sale of partridges, but was unable to get evidence to convict, as both parties announced their intention of swearing the birds were a gift. The buyer is a man who was prominent in having the anti-sale law passed. I do not think there has been a snare set in this vicinity this year. . . .

Respectfully, GEORGE E. WHITEHEAD,
Deputy.

LEICESTER, Nov. 10, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I have spent most of my spare time in the protection of game and fish. . . . There is very little illegal work done in this town. There has been some fishing in Henshaw Pond on days that they should not fish, but I have not been able to catch them as yet. Game seems plentiful, and some good bags have been brought in. . . . I have not had to make an arrest this year. . . .

Respectfully, TIMOTHY MCCARTHY,
Deputy.

WEST UPTON, Nov. 23, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — I am glad to say there has been a decided improvement in the observance of Sunday hunting and fishing the past year here. I have been able to learn of but two instances where guns were heard on Sunday.

I was disappointed to find so few partridges, for there was a good number left over last year. I believe the wet weather in May had something to do with it. This bird needs all the protection it possibly can get. . . . The woodcock have been rather scarce, but quail were very plentiful; I never saw so many here before. Rabbits and squirrels are very numerous. A number of deer have been seen in this locality this year. . . .

I have made no arrests, as the sportsmen have lived up to the laws very well. I distributed the abstracts of the fish and game laws you sent me among interested parties.

Respectfully, DANIEL A. WARREN,
Deputy.

OXFORD, NOV. 22, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — Since receiving our appointments we have kept diligent watch of all hunters in this town, part of Charlton, Sutton and Auburn, and have seen nothing out of the way. We have spent every Saturday night, and all of each Sunday, looking after ferret hunters and snares, but have not found a single one so far, — something unusual for this section. The law prohibiting the sale of game birds has put an end to pot hunting. Partridges are plentiful this year, and quail are also, but very wild. Woodcock are never extra plentiful in this section. Hares are also quite numerous. Sunday gunning has gone out of fashion hereabouts. . . .

Respectfully, ARCHIBALD CAMPBELL,
JAMES H. CARLING,
Deputies.

WORCESTER, NOV. 21, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . From May until November I was confined, so it was impossible for me to make any arrests. I have been in the woods some, and I think the shortening of the open season is a step in the right direction, only carry it farther, and make it a crime to have a dog or gun in the woods or brush either Sunday or during the close season.

Respectfully, HENRY A. MOWER,
Deputy.

FISKDALE, NOV. 9, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . No large trout or bass were taken this season. Partridges and quail were plenty, but woodcock were scarce. Deer have been seen quite often by farmers, and I have failed to hear of any one hunting or chasing them. I think the game laws have been observed better this year than last. Prohibiting the sale of birds has made them more plentiful, and I hope it will remain so for a number of years.

Respectfully, J. W. ROBINSON,
Deputy.

CHARLTON, NOV. 10, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — Game is about the same as last season, so far as quail and partridge are concerned. I have put in quite a lot of time looking after Sunday shooting, but have not heard a gun on Sunday this season, and so there have been no arrests.

Respectfully, CHARLES H. BALDWIN,
Deputy.

WEBSTER, Nov. 21, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — I have made no arrests for violation of fish and game laws. I am satisfied there are few violations. . . .

Game birds are about as usual, except quail, which are more plentiful. The song and insect eating birds are numerous. If we could dispense with cats and English sparrows, I think we could have a little paradise of song birds in our villages. The cats stand ready to catch every young robin that leaves its nest. . . .

Respectfully, RUFUS C. HALL,
Deputy.

WEBSTER, Nov. 23, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — I have made no arrests, having known of no occasion for so doing. I have taken a large . . . gill net that I found in the woods near a pond in the town of Dudley. . . .

Hunters have seen two Mongolian pheasants that were released by your agent in this locality. Partridge are very scarce and quail are plentiful.

Respectfully, CHARLES B. ADAMS.
Deputy.

FITCHBURG, Nov. 26, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I took the oath of office Oct. 12, 1901. October 20 [Sunday] I went out, but found no hunters. The 27th I found six, and gave them a chance to go home, on condition they would do no more Sunday hunting. November 3 I found five hunters, and gave them the same chance; I told them if I caught them again I should certainly arrest them. November 10 I found four, and sent them home; November 17 I found six, and sent them home; November 24 I did not find any. I have given all my time for the last six Sundays, . . . and am sure I have stopped seven-tenths of the Sunday hunting here. . . .

Deer are getting quite plenty here; they are seen often. . . .

Respectfully, C. O. GIBSON,
Deputy.

FITCHBURG, Nov. 19, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . No arrests have been made. I have warned quite a number, but in no case have had occasion to give a second warning.

Quail liberated here by the Fitchburg Rifle and Gun Club have produced broods of from twelve to fifteen. Pheasants were more numerous last spring, and I have seen two broods in August. The game laws have been very well respected in this section.

Respectfully, **FRED J. PROCTOR,**
Deputy.

SPENCER, Nov. 20, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . Partridges and quail are increasing, and are more plentiful in this vicinity than they have been for a number of years.

Respectfully, **JAMES A. SPENCER,**
Deputy.

ATHOL CENTRE, Nov. 20, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . Trout fishing has been very fair; some good catches have been made on the stocked brook. We are in hopes to see better results next year, as the brooks have not dried up this summer. . . .

Grouse are not very plenty. Gray squirrels are numerous. The white rabbit is nearly gone, and hunting the little gray is about all the sport the boys have. Deer are seen often; one man reports seeing four as he came to town to-day. . . . I have no violations of fish and game laws to report.

Respectfully, **W. H. FROST,**
Deputy.

PETERSHAM, Nov. 23, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I have caused no arrests to be made. . . . But very little Sunday hunting has been done, and if our fish and game laws have been violated, I do not think it has been done by any of my townspeople. . . .

Respectfully, **J. H. GAFNEY,**
Deputy.

WEST GARDNER, NOV. 11, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I have made it a rule to inform the public relative to the fish and game laws, and had the laws printed in the local newspaper. I personally notified persons who I thought were breaking the game laws, and assured them if they continued they would not be spared. . . .

Trout have been more than ordinarily plentiful in this vicinity during the present year, and the brooks are well stocked with small ones. A party that was out fishing May 17 found a gill net in Perley Brook; they took the net out of the brook and brought it to me. . . . On June 29 I was notified that one of the trout brooks in the north part of the town, called the Eaton Brook, had run dry, and several thousands of the State trout would die if they were not taken out. I drove to the brook at once, and found the trout in a little pool of muddy water. I took the trout out . . . and put them in Perley Brook in a place that never runs dry, and thus saved two pails full of young trout from one to six inches long that would have died in a short time.

Partridge, quail, woodcock, ducks and squirrels have been fairly plentiful in this vicinity. . . . Hares and rabbits are very scarce here. . . . Deer have been seen in a few places, accompanied by their young. Farmers report seeing them grazing with stock in the pasture. No attempt has been made to harm them in any way. . . .

Respectfully, FRED S. CASAVANT,
Deputy.

GREENWICH, NOV. 22, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I have not spent as much time as a deputy commissioner as I would like, but my business has been such I could not give more time. Game birds are quite plentiful. . . .

Respectfully, W. S. WARD,
Deputy.

(3) *Western Section of the State.*

SPRINGFIELD, NOV. 25, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . In previous years I have had many complaints in regard to Italians shooting song birds, but this year I have not received any. I have kept close watch of them all through the summer, and, as near as I can find out, there has been very little if any of it done.

Respectfully, **W. S. Wheeler**,
Deputy.

Ware, Nov. 19, 1901.

To the Commissioners on Inland Fisheries and Game.

Gentlemen: — . . . I have warned a number of people, who have made a practice of Sunday hunting, to desist, and am glad to report that in all cases they have complied with the request. The same may be said of those I have warned not to set snares or hunt with ferrets.

Game is quite plentiful, but the present laws do not protect, to any great extent, partridge, quail or woodcock, as a good shot can get from ten to thirty in a day. A law should be passed prohibiting the taking of more than five birds in any one day by any one person, and a fine should be the penalty for violations of that law; and the possession of more than that number by any person in the vicinity where partridge, quail or woodcock abound should constitute evidence to convict. With this and certain other additions, the present fish and game laws would be satisfactory.

The practice of hunting with ferrets is carried on to some extent in the smaller towns. . . . I have found an unusual number of "dead falls" or "figure four," but, as nearly all were baited with meat, it is probable they were set for skunks, foxes or other animals not protected.

I have found the public generally in favor of the fish and game laws, and the only complaint is that the deputies do not have sufficient authority to successfully enforce the laws.

Respectfully, A. H. Eldredge,
Deputy.

Colrain, Nov. 25, 1901.

To the Commissioners on Inland Fisheries and Game.

Gentlemen: — . . . Since I have been deputy I have stopped Sunday hunting, also most of the Sunday fishing. . . . I have made no arrests. . . .

I have looked at several stocked brooks and find the trout are doing well. If the fishermen will let them alone, it will be but a few years before there will be plenty of trout.

Woodcock seem to be quite numerous, while partridge are not as plentiful as usual, and think it is owing to the wet spring.

Respectfully, C. N. Carpenter,
Deputy.

BUCKLAND, Nov. 27, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . Game has been fairly plentiful this season, with the exception of ruffed grouse, which are scarce, though more abundant than last year. I have not killed one for three seasons. I do not think any game has been sold or illegally killed in this section during the past year.

Respectfully, E. C. HALL,
Deputy.

BUCKLAND, Nov. 24, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . There are not many fish found in these streams, and but few six-inch trout. If this six-inch law is enforced for a few years, I think the trout will be more abundant. . . .

Gray squirrels are very abundant this fall, but there are not many partridges. A young deer came to one of our neighbors last May, and has stayed around his farm all summer, and is just as tame as his dog. He goes around the house and barn when he wants to, but he has never been confined. . . .

Respectfully, MILFORD J. CRANSON,
Deputy.

PLAINFIELD, Oct. 17, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I have not arrested any one. I have not found any one with small trout except boys, and I thought it would serve our purpose better to give them notice that if they were caught again I should take them. . . . Every one heeded the warning. I found a Mr. Neigh who had a small ice pond, and his boys were putting small trout into it. . . . They thought they had a right to catch them and put them in the pond. They had about one hundred and fifty trout in the pond, but he said he would put them back into the brook, and he did while I was there. There has not been over half the fishing this year that there was last. . . .

Respectfully, SHEPARD M. DYER,
Deputy.

BECKET, Nov. 19, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I have had complaint made to me in two cases of owners of sawmills running sawdust into trout streams. I notified them that I should report to the commissioners if it was not stopped, and they have disposed of it otherwise since.

I have had complaint made to me of two or three cases of shooting before the law was off, but on looking the matter up, found there was no evidence to warrant an arrest. I think there has been no snaring done in this vicinity this season, and not the usual amount of shooting.

There are apparently more birds this season than common. . . . I had a report to-day of four deer located about two miles from the village, and they seem to be quite plenty. The trout season was not as good as last year; not so many caught, but larger. . . .

There is some Sunday fox hunting about here, but I have taken no steps to stop it, as every fox killed is in the interest of game protection.

Respectfully, W. J. CROSS,
Deputy.

CUMMINGTON, Nov. 18, 1901.

To the Commissioners on Inland Fisheries and Game.

GENTLEMEN: — . . . I have made no arrests. There were two or three instances where I could have made arrests, but I think good results were obtained without going to court. I will cite two cases. I was informed that a man in Plainfield was catching trout from a stream which had been stocked yearly from the State hatchery, and was open to the public. Report said he was catching trout under size from this stream, and stocking a private pond on his own land. I saw the man and talked with him. As soon as he found out what was wanted, and heard he was breaking the law, he very readily agreed to stop, and also to destroy the fish pond and restore trout under size to the stream, all of which I saw done. There was also a complaint made to me that some boys in town were killing song birds. On investigation, I found it was true. I interviewed the boys, and explained the law in regard to the protection of song birds. They then promised to respect the law in the future, and I am very sure they did.

I have not seen any one in this vicinity with under-sized trout in their possession. There was less trout fishing here this year than usual. The streams were well stocked with trout about four and one-half to five and one-half inches long. We have several fine natural trout brooks here, which it will pay to keep stocked. We can see good results from planting fry in the past.

Game was scarce here this fall. Pheasants are seen occasionally; they have been sent here by the State the past two years. There is excellent cover about here for game birds. Deer are seen in this vicinity quite often.

Respectfully, **George W. Holt,**
Deputy.

Adams, Nov. 12, 1901.

To the Commissioners on Inland Fisheries and Game.

Gentlemen: — . . . I have made no arrests. Partridge are very plentiful this year. I have not seen as many for several years. Rabbits are scarce, as there has been a great deal of ferreting done through this section. . . . Deer are becoming very plentiful.

Trout are scarce, and are becoming more so every year. The streams are well stocked with small ones, but they do not get a chance to grow. Berkshire County should have a six-inch law, the same as other counties. . . .

I have seen one pheasant, — a male bird. . . . There are a great many foxes, and some of the sportsmen think the State should put a bounty on them, as they destroy a great many partridge and rabbits.

Respectfully, **Frank E. O'Neill,**
Deputy.

Hoosac Tunnel, Nov. 24, 1901.

To the Commissioners on Inland Fisheries and Game.

Gentlemen: — . . . I have made no arrests. . . . Trout are plenty, and the brooks were well stocked when the season closed this fall. Birds and other game are quite numerous, with an apparent increase in the number of white rabbits.

Deer are seen frequently, and, if the dogs would leave them alone, would increase rapidly. I found a yearling buck which had, I think, died from natural causes, as it was not torn by dogs, and did not show that it had been shot. . . .

Respectfully, **Lyman E. Ruberg,**
Deputy.

[H.]

REPORT UPON CONVICTIONS, FINES, ETC., FOR VIOLATIONS OF FISH AND GAME LAWS.

STATE v.—	TOWN OR CITY.	Offence.	Court Decision.	Fine.
Alfred A. Doerfler,	Tisbury,	Killing pheasant,	Convicted,	$20 00
Reuben B. Hardy,	Falmouth,	Illegal fishing,	Convicted,	5 00
William Crosby,	Cotuit,	Short lobsters,	Convicted,	5 00
Frank Bassett,	Barnstable,	Unmarked lobster car,	Convicted,	10 00
Lewis B. Rogers,	Chatham,	Sunday hunting,	Convicted,	5 00
George Priaulx,	South Dartmouth,	Illegal fishing,	Convicted,	50 00
Arthur H. Norris,	Fairhaven,	Illegal fishing,	Convicted,	10 00
Foster G. Sherman,*	Fall River,	Short lobsters,	Convicted,	–
William Muirhead,	Hanson,	Sunday hunting,	Convicted,	20 00
Henry E. Phillips,	Marshfield,	Short lobsters,	Convicted,	59 00
Alfred J. Clements,	North Attleborough,	Killing deer,	Discharged,	–
Thornton H. Adams,	North Attleborough,	Killing deer,	Discharged,	–
Mathew Hiney,	North Attleborough,	Killing deer,	Discharged,	–
Lewellyn E. Mowry,	Providence, R. I.,	Sunday hunting,	Convicted,	5 00
Carl E. Wilson,	East Providence, R. I.,	Taking game out of State,	Discharged,	–
Fricher Minigasta,	Woonsocket, R. I.,	Sunday hunting,	Convicted,	4 00
Antonia Boulier,	Woonsocket, R. I.,	Sunday hunting,	Convicted,	4 00
Benjamin F. Monroe,	Rehoboth,	Sunday hunting,	Convicted,	5 00
William C. Hay,	South Bellingham,	Sunday hunting,	Convicted,	5 00
Joseph Galligan,	Canton,	Sunday hunting,	Discharged,	–
John Sandstrom,	Hull,	Short lobsters,	Convicted,	10 00
Joseph Crodor,	Hull,	Short lobsters,	Convicted,	50 00
George Hammond,	Hull,	Sunday hunting,	Convicted,	5 00
Austin Crocker,	Nantasket,	Sunday hunting,	Convicted,	5 00
Henry W. Phillips,	Weymouth,	Illegal fishing,	Convicted,	50 00

Walter Phillips,	Weymouth,	Illegal fishing,	Convicted,	50 00
William Lobesty,	Weymouth,	Illegal fishing,	Convicted,	5 00
Wm. Ammoschiverity,	Weymouth,	Illegal fishing,	Convicted,	5 00
Joseph Materia,	Weymouth,	Illegal fishing,	Convicted,	5 00
Edward Anderson,	Weymouth,	Egg-bearing and short lobsters,	Convicted,	15 00
Antonio S. Veader,	Weymouth,	Mutilated lobsters,	Convicted,	10 00
Nathaniel W. Bates,	Weymouth,	Sunday hunting and killing game out of season,	Convicted,	60 00
Joseph Woodman,	Braintree,	Illegal fishing,	Convicted,	5 00
Eli Eddy,	Braintree,	Illegal fishing,	Convicted,	5 00
Tony Limona,	Braintree,	Shooting song birds,	Convicted,	10 00
Henry Hume,	Quincy,	Illegal fishing,	Convicted,	5 00
Aleck Hume,	Quincy,	Illegal fishing,	Convicted,	5 00
Charles Reveire,	Quincy,	Illegal fishing,	Convicted,	5 00
Frank Howard,	Quincy,	Illegal fishing,	Convicted,	5 00
Lars Wahl,	Quincy,	Illegal fishing,	Convicted,	5 00
Fred Fogg,	Quincy,	Illegal fishing,	Convicted,	10 00
Harry Swain,	Quincy,	Illegal fishing,	Convicted,	10 00
Charles Waterhouse,	Quincy,	Illegal fishing,	Convicted,	5 00
Charles Peterson,	Quincy,	Short lobsters,	Convicted,	25 00
Charles P. Rolfe,	Milton,	Illegal fishing,	Convicted,	50 00
Timothy Sullivan,	Milton,	Illegal fishing,	Convicted,	10 00
Edward Conarty,	– –	Interfering with a prisoner,	Convicted,	5 00
Francisco Brignoli,	Boston,	Short and egg-bearing lobsters,	Convicted,	40 00
Peter Sullivan,*	Boston,	Shooting tern,	Convicted,	–
Windson Drisco,	Boston,	Shooting tern,	Convicted,	10 00
Joseph Antonio,	Boston,	Shooting robins,	Convicted,	10 00
George L. Gordon,	Watertown,	Sunday hunting,	Convicted,	10 00
Walter E. Merryman,	Beachmont,	Short and mutilated lobsters,	Convicted,	275 00
James Carlucci,	Lynn,	Illegal hunting,	Convicted,	5 00
Frank Mossary,	Lynn,	Illegal hunting,	Convicted,	5 00
Peter Freeny,	Lynn,	Short lobsters,	Convicted,	10 00

* On file.

Report upon Convictions, Fines, etc., for Violations of Fish and Game Laws — Continued.

STATE v.—	TOWN OR CITY.	Offence.	Court Decision.	Fine.
Robert N. Bentley,	Salem,	Sunday fishing,	Discharged,	-
Walter I. Jones,	Marblehead,	Short and egg-bearing lobsters,	Convicted,	$45 50
Melvin Cook,	Gloucester,	Shooting partridge out of season,	Discharged,	-
Howard Haskell,	Gloucester,	Illegal hunting,	Convicted,	20 00
Joseph F. Ainsworth,	Amesbury,	Illegal fishing,	Convicted,	*20 00
August Simon,†	Lawrence,	Fishing in closed pond,	Convicted,	-
Robert Bluemen,†	Lawrence,	Fishing in closed pond,	Convicted,	-
Gustave Shaffel,	Lawrence,	Fishing in closed pond,	Convicted,	10 00
August Bluemen,	Lawrence,	Fishing in closed pond,	Convicted,	10 00
Samuel F. Hildreth,	Lowell,	Ferreting,	Convicted,	20 00
John Matthews,	Lowell,	Illegal fishing,	Convicted,	10 00
John Noval,	Lowell,	Illegal fishing,	Convicted,	10 00
C. H. Ruskin,	Milford,	Sunday hunting,	Convicted,	10 00
J. H. Foster,	Worcester,	Sunday hunting,	Convicted,	5 00
A. B. Burnell,	Worcester,	Sunday fishing,	Convicted,	5 00
A. Girad,	Worcester,	Sunday fishing,	Convicted,	5 00
James H. Fisher,	Worcester,	Sunday hunting,	Convicted,	5 00
Fred Hulbert,	Worcester,	Sunday hunting,	Convicted,	5 00
W. Herbert,	Worcester,	Sunday hunting,	Convicted,	5 00
Fred Taylor, Jr.,‡	Worcester,	Illegal fishing,	Convicted,	5 00
John Brown, Jr.,‡	Worcester,	Illegal fishing,	Convicted,	5 00
Axel W. Carlson,	Worcester,	Illegal fishing,	Convicted,	10 00
Winfred Doane,	Brookfield,	Illegal fishing,	Discharged,	-
T. J. Manly,	North Brookfield,	Sunday fishing,	Convicted,	5 00
E. Scudder,	North Brookfield,	Sunday fishing,	Convicted,	5 00
Samuel Berard,	Roachdale,	Sunday hunting,	Convicted,	5 00
Charles Berard,	Roachdale,	Sunday hunting,	Convicted,	15 00

L. Lupien,	Spencer,	Sunday hunting,	Convicted,	5 00
Eli Lupin,	Spencer,	Sunday fishing,	Convicted,	5 00
William M. Bourchard,	Southbridge,	Sunday hunting,	Discharged,	–
Adolph Lasanaugh,	Southbridge,	Illegal fishing,	Convicted,	7 50
Louis Proulx,	Southbridge,	Illegal fishing,	Convicted,	7 50
Henry Cadieux,	Palmer,	Sunday fishing,	Convicted,	5 00
Walter LaDuke,	Palmer,	Ferreting,	Discharged,	–
Fred Bishop,	Palmer,	Ferreting,	Discharged,	–
George Smith,	Palmer,	Ferreting,	Discharged,	–
Harry Bond,	Palmer,	Ferreting,	Discharged,	–
Hilliard Smith,	Palmer,	Ferreting,	Discharged,	–
Eugene Saunders,	Oakham,	Sunday hunting,	Convicted,	5 00
Israel Harness,	West Brimfield,	Sunday hunting and fishing,	Convicted,	5 00
Louis Harness,	West Brimfield,	Sunday fishing,	Convicted,	5 00
John Harness,§	West Brimfield,	Sunday fishing,	Convicted,	–
A. Harness,§	West Brimfield,	Sunday fishing,	Convicted,	–
W. A. Ruddock,	Enfield,	Sunday fishing,	Convicted,	6 00
Charles W. Jones,	Enfield,	Sunday fishing,	Convicted,	6 00
Charles Gardner,	Enfield,	Sunday fishing,	Convicted,	6 00
George Ellis,	New Salem,	Illegal hunting,	Convicted,	10 00
A. W. Erickson,‖	Gardner,	Sunday fishing,	Convicted,	3 66
David Goddard,	Rutland,	Sunday hunting,	Convicted,	20 00
David Taylor,	Rutland,	Sunday hunting,	Convicted,	10 00
John Alvey,	Ware,	Illegal hunting,	Discharged,	–
John Dalton†,	Monson,	Sunday fishing,	Convicted,	–
Henry Hall,¶	Monson,	Sunday fishing,	Convicted,	5 00
Homer Bradway,**	Monson,	Killing pheasant,	Convicted,	–

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* Judge afterward remitted the fine.

† On file.

‡ It is believed these names were assumed.

§ On file. These were boys, and for this reason the court put their cases on file.

‖ In this case only the cost of court was paid, and the case was filed.

¶ Appealed.

** A boy. Case filed, with full approval of commission.

Report upon Convictions, Fines, etc., for Violations of Fish and Game Laws — Concluded.

STATE *v.* —	TOWN OR CITY.	Offence.	Court Decision.	Fine.
Ernest Yotte,	Ludlow,	Sunday hunting,	Discharged,	-
Francis Brennan,	North Hatfield,	Sunday fishing,	Convicted,	$5 00
Thomas Coffey,	North Hatfield,	Sunday fishing,	Convicted,	5 00
C. S. Smith,	Granby,	Sunday hunting,	Convicted,	5 00
H. L. Easton,	Granby,	Sunday hunting,	Convicted,	5 00
Bilesino Antonio,	Granby,	Sunday hunting,	Convicted,	5 00
Fred W. Kempkis,	Hadley,	Illegal and Sunday hunting,	Convicted,	30 00
Alfred McDonald,	Holyoke,	Sunday hunting,	Convicted,	6 00
Joseph Deroches,	Holyoke,	Sunday hunting,	Convicted,	6 00
Peter Bonfiglio,	Holyoke,	Sunday fishing,	Convicted,	6 00
Joseph Parker,	Holyoke,	Sunday fishing,	Case withdrawn,	-
Frank St Clair,	Holyoke,	Sunday fishing,	Convicted,	5 00
John Tait,	Holyoke,	Sunday fishing,	Convicted,	5 00
Thomas Diamond,	Holyoke,	Sunday fishing,	Convicted,	6 00
Patrick Fitzgibbons,	Holyoke,	Sunday fishing,	Convicted,	6 00
Edward Griffin,	Holyoke,	Sunday fishing,	Convicted,	6 00
Robert Suyden,	Holyoke,	Sunday fishing,	Convicted,	6 00
William Connors,	Holyoke,	Sunday fishing,	Convicted,	6 00
Henry Davis,	Holyoke,	Sunday hunting,	Convicted,	6 00
Peter Viens,	Chicopee Falls,	Sunday hunting,	Discharged,	-
Stephen Duprey,	Chicopee Falls,	Sunday hunting,	Discharged,	-
Patrick Caven,	Chicopee Falls,	Sunday hunting,	Discharged,	-
Albert Curtis,	Springfield,	Sunday hunting,	Convicted,	6 00
Edward Franklin,	Springfield,	Sunday hunting,	Convicted,	6 00
A. P. Casey,	Springfield,	Killing game in close season,	Discharged,	-
Charles H Stebbins,	Springfield,	Sunday fishing,	Convicted,	5 00
Fred Needham,	Springfield,	Sunday fishing,	Convicted,	5 00

George Harris,	Agawam,	Sunday hunting,	Convicted,	5 00
John Merry,	Agawam,	Sunday hunting,	Convicted,	5 00
Benjamin Babb,	Southwick,	Illegal fishing,	Convicted,	30 00
Charles Frisbee,	West Granville,	Illegal hunting,	Convicted,	10 00
Cassius C. Scranton,	New Marlborough,	Short bass,	Convicted,	2 00
John Burk,	Monterey,	Sunday hunting,	Convicted,	3 00
John Martin,	Monterey,	Sunday hunting,	Convicted,	3 00
William Martin,	Monterey,	Sunday hunting,	Convicted,	3 00
Fred Gorham,	Great Barrington,	Sunday hunting,	Convicted,	3 00
Fred Jones,	Pittsfield,	Sunday hunting,	Convicted,	1 00
Charles Wilson,	Pittsfield,	Sunday hunting,	Convicted,	1 00
John Boyle,	Pittsfield,	Sunday hunting,	Convicted,	1 00
Bert Godermote,	Clarksburg,	Sunday hunting,	Convicted,	5 00
Norman Springer,	East Charlemont,	Killing deer,	Discharged,	–
Fred Stoheker,	Buckland,	Short trout,	Convicted,	10 00
Harry Stohcker,	Buckland,	Short trout,	Convicted,	10 00
L. A. Hawkes,	Brooklyn, N. Y.,	Illegal fishing,	Convicted,	2 00
C F. Reynolds,	Brooklyn, N. Y.,	Illegal fishing,	Convicted,	2 00
C. A. Castello,	Brooklyn, N. Y.,	Illegal fishing,	Convicted,	2 00

[I.]

LEGISLATION.

Acts of 1901.

[CHAPTER 102.]

AN ACT RELATIVE TO THE TAKING OR KILLING OF GRAY SQUIRRELS, HARES AND RABBITS.

Be it enacted, etc., as follows:

SECTION 1. Section one of chapter ninety-seven of the acts of the year eighteen hundred and ninety-four is hereby amended by striking out in the third line, the words "fifteenth day of September", and inserting in place thereof the words: — first day of October, — and by adding at the end thereof the words: —*provided, however*, that any person, firm or corporation dealing in game or engaged in the cold storage business may buy, sell or have in possession, and any person may buy from such person, firm or corporation, and have in possession if so bought, Colorado jack rabbits, Nova Scotia white or eastern white rabbits at any season, if not taken or killed in this Commonwealth contrary to the provisions of this act, — so as to read as follows: — *Section 1.* Whoever takes or kills a gray squirrel, hare or rabbit, between the first day of March and the first day of October, or within said time buys, sells or offers for sale any of said animals, shall be punished by a fine of ten dollars: *provided, however*, that any person, firm or corporation dealing in game or engaged in the cold storage business may buy, sell or have in possession, and any person may buy from such person, firm or corporation, and have in possession if so bought, Colorado jack rabbits, Nova Scotia white or eastern white rabbits at any season, if not taken or killed in this Commonwealth contrary to the provisions of this act.

SECTION 2. This act shall take effect upon its passage. [*Approved March 5, 1901.*

[CHAPTER 119.]

AN ACT TO PROVIDE FOR THE PROTECTION OF SHELLFISH IN THE TOWN OF BERKLEY.

Be it enacted, etc., as follows:

SECTION 1. No person shall take any shellfish from their beds or wilfully obstruct the growth of any shellfish within the town of Berkley, except as is hereinafter provided.

SECTION 2. The selectmen of said town may give permits in writing to any person to take shellfish from their beds within said town, at such times, in such quantities and for such uses, as they shall deem expedient. Said selectmen may withhold all such permits for such time as they deem expedient. But any inhabitant of said town may without such permit take from the beds in said town shellfish for the use of his family, not exceeding in quantity one bushel, including shells, in any one day; and any fisherman may without such permit take shellfish from the said beds for bait for his own use, not exceeding in quantity one bushel, including shells, in any one day. Shovels shall not be used at any time below low water mark. Forks may be used by permit from the selectmen, but not otherwise.

SECTION 3. No little neck clams or quahaugs less than one and one half inches across the widest part shall be taken from their beds in said town.

SECTION 4. Whoever violates any provision of this act shall be punished by a fine of not less than ten nor more than one hundred dollars.

SECTION 5. District courts and trial justices shall have concurrent jurisdiction with the superior court of all offences under this act.

SECTION 6. So much of sections sixty-eight and sixty-nine of chapter ninety-one of the Public Statutes as conflicts herewith shall not apply to the town of Berkley. [*Approved March 6, 1901.*

[CHAPTER 121.]

AN ACT TO PROVIDE FOR THE BETTER PROTECTION OF TROUT.

Be it enacted, etc., as follows:

SECTION 1. Whoever takes, catches or has in possession at any time trout less than six inches in length shall be fined ten dollars for every such trout taken, caught or held in possession: *provided*, that this act shall not apply to any person engaged in breeding or rearing trout, or to any one who on taking such trout immediately returns it alive to the water from which it was taken.

SECTION 2. This act shall not apply to the county of Berkshire. [*Approved March 7, 1901.*

[CHAPTER 141.]

AN ACT RELATIVE TO THE SNARING OF PARTRIDGES, HARES AND RABBITS.

Be it enacted, etc., as follows:

Chapter three hundred of the acts of the year eighteen hundred and eighty-seven is hereby amended by striking out the word "January", in the last line, and inserting in place thereof the word: — December, — so as to read as follows: — The provisions of section six of chapter two hundred and seventy-six of the acts of the year eighteen hundred and eighty-six, shall not apply to the trapping or snaring of ruffed grouse, commonly called partridge, hares or rabbits by an owner of land upon his land, or by a member of the family of such owner if authorized by such owner, between the first day of October and the first day of December. [*Approved March 12, 1901.*

[CHAPTER 142.]

AN ACT TO INCLUDE THE MONTH OF AUGUST IN THE CLOSE SEASON FOR TROUT FISHING IN THE COUNTY OF HAMPDEN.

Be it enacted, etc., as follows:

SECTION 1. Chapter one hundred and thirty-eight of the acts of the year eighteen hundred and ninety-one is hereby repealed.

SECTION 2. This act shall take effect upon its passage. [*Approved March 12, 1901.*

[CHAPTER 158.]

AN ACT TO PROHIBIT FISHING IN LAKE QUINSIGAMOND AND ITS TRIBUTARIES DURING CERTAIN MONTHS OF THE YEAR.

Be it enacted, etc., as follows:

SECTION 1. For a period of five years after the passage of this act no person shall fish in any manner whatsoever between the first day of September and the first day of April in each year in Lake Quinsigamond in the county of Worcester, or in its tributaries, above what is known as the Stringer dam, including Full Moon cove, Jordan pond and Newton pond commonly called Mud pond; and between the first day of April and the first day of September in each year during said period no person shall take from said lake or its tributaries as aforesaid any fish in any manner except with a single hook and either a hand line or a line attached to a rod or pole held by hand, with bait, artificial fly or spoon.

SECTION 2. No person shall take any fish from said lake or its tributaries as aforesaid during said period of five years for the purpose of sale, trade or barter.

SECTION 3. Any person violating any provision of this act shall be punished by a fine of not less than twenty and not more than fifty dollars, or by imprisonment for not less than twenty nor more than fifty days, and shall be subject to a further penalty of one dollar for each fish taken or killed in violation of this act. [*Approved March 14, 1901.*

[CHAPTER 163.]

AN ACT FOR THE BETTER PROTECTION OF THE FISHERIES IN THE WATERS OF PLEASANT BAY AND ITS TRIBUTARIES IN THE TOWN OF ORLEANS.

Be it enacted, etc., as follows:

SECTION 1. No purse or sweep seines, set nets or gill nets for the taking of fish shall be set, drawn, used or maintained in the waters of Pleasant bay or its tributaries in the town of Orleans; but nothing herein contained shall be construed to forbid or make unlawful the maintaining of traps, pounds or weirs under licenses heretofore granted in accordance with section seventy of chapter ninety-one of the Public Statutes, until the expiration of the terms for which such licenses were granted.

SECTION 2. Any person who shall set, draw, use or maintain a purse or sweep seine, set net or gill net in violation of this act shall be punished by a fine of not less than one hundred nor more than five hundred dollars, or by imprisonment for a term not exceeding six months. [*Approved March 20, 1901.*

[CHAPTER 174.]

AN ACT RELATIVE TO THE PROTECTION OF WILD FOWL.

Be it enacted, etc., as follows:

SECTION 1. Section one of chapter one hundred and eighty-four of the acts of the year eighteen hundred and ninety-seven is hereby amended by striking out the words "any mechanical means", in the seventh line, and inserting in place thereof the words: — steam, naphtha, gasolene, electricity, compressed air or any other similar motive power, — so as to read as follows: — *Section 1.* Whoever within the limits of that portion of Boston harbor lying westerly and southwesterly of a line running from Deer Island to Point Allerton, including the waters of Dorchester bay, Quincy bay, Weymouth bay and Hingham bay, shoots at, kills or purses any wild fowl from or by the aid or use of any boat or floating device propelled by steam, naphtha, gasolene, electricity, compressed air or any other similar motive power shall be punishable by a fine of twenty dollars for each offence.

SECTION 2. All acts and parts of acts inconsistent herewith are hereby repealed.

SECTION 3. This act shall take effect upon its passage. [*Approved March 21, 1901.*

[CHAPTER 178.]

AN ACT TO PROVIDE FOR THE FURTHER PROTECTION OF WILD PIGEONS, GULLS AND TERN.

Be it enacted, etc., as follows:

Section two of chapter two hundred and seventy-six of the acts of the year eighteen hundred and eighty-six is hereby amended by striking out the words "between the first day of May and the first day of October", in the fifth and sixth lines, and inserting in place thereof the words: — at any time, — and by adding at the end of said section the words: — *provided, however*, that this section shall not apply to the great American herring gull nor to the great black backed gull between the first day of November and the first day of May following, — so as to read as follows: — *Section 2.* Whoever takes or kills a plover, snipe, sandpiper, rail, or any of the so-called shore, marsh or beach birds, between the first day of May and the fifteenth day of July, or a wild or passenger pigeon, or a gull, or a tern, at any time, shall be punished by a fine of ten dollars for every bird so taken or killed: *provided, however*, that this section shall not apply to the great American herring gull nor to the great black backed gull between the first day of November and the first day of May following. [*Approved March 21, 1901.*

[CHAPTER 184.]

AN ACT TO PROVIDE FOR THE PROTECTION OF FISH IN LEWIS BAY AND ITS TRIBUTARIES.

Be it enacted, etc., as follows:

SECTION 1. No person shall draw, set, stretch or use any drag net, or purse or sweep seine of any kind for taking fish anywhere in the waters of Lewis bay and its tributaries in the county of Barnstable.

SECTION 2. Any net or seine used in violation of any provision of this act shall be forfeited; and it shall be lawful for any inhabitant or inhabitants of any town bordering on said bay to seize and detain, for a period not exceeding forty-eight hours, any net or seine found in use contrary to the provisions of this act, to the end that the same may be seized and libelled, if need be, by due process of law.

SECTION 3. Whoever violates any provision of this act or aids or assists in violating the same shall be punished by fine not exceeding two hundred dollars for each offence.

SECTION 4. District courts and trial justices shall have concurrent jurisdiction with the superior court of all offences and proceedings under the provisions of this act. [*Approved March 21, 1901.*

[CHAPTER 193.]

AN ACT TO PROVIDE FOR THE BETTER PROTECTION OF EGG-BEARING LOBSTERS.

Be it enacted, etc., as follows:

Section one of chapter one hundred and nine of the acts of the year eighteen hundred and eighty-nine is hereby amended by adding at the end thereof the words: — and *provided, also,* that exposure for sale, or possession otherwise than as provided for herein, shall be prima facie evidence of intent to sell, — so as to read as follows: — *Section 1.* Whoever during any season of the year catches or takes, and whoever has in his possession in this Commonwealth, with intent to sell, any female lobster bearing eggs, shall be punished for each offence by a fine of not less than ten nor more than one hundred dollars, or by imprisonment in the house of correction for not less than one nor more than three months: *provided, however,* that a person catching and taking any such lobster and immediately returning it alive to the waters from which it was taken, shall not be subject to such penalty; and *provided, also,* that this act shall not apply to lobsters spawning in lobster cars, if they are immediately returned alive to the waters as aforesaid, and *provided, also,* that exposure for sale, or possession otherwise than as provided for herein, shall be prima facie evidence of intent to sell. [*Approved March 26, 1901.*

[CHAPTER 225.]

AN ACT TO PROVIDE FOR THE PROTECTION OF GAME BIRDS AND ANIMALS IN THE TOWN OF ESSEX.

Be it enacted, etc., as follows:

Section one of chapter two hundred and eighty-nine of the acts of the year eighteen hundred and ninety-nine is hereby amended by striking out the whole of said section and inserting in place thereof the following: — *Section 1.* Whoever takes or kills a rabbit, gray squirrel or chipmunk, or any kind of land bird, except beach or marsh birds, and except the English sparrow, within the limits of the town of Essex, at any time before the twentieth day of April in the year nineteen hundred and four, shall be punished by a fine of twenty dollars for every such rabbit, squirrel, chipmunk or bird so taken or killed. [*Approved April 2, 1901.*

[Chapter 237.]

An Act relative to the Taking of Scallops in the Waters adjacent to Nantucket.

Be it enacted, etc., as follows:

Section 1. The provisions of section one of chapter two hundred and sixty-eight of the acts of the year eighteen hundred and ninety-six shall not apply to the taking of scallops for bait in the waters adjacent to the town of Nantucket from the first day of April to the fifteenth day of May, inclusive.

Section 2. This act shall take effect upon its passage. [*Approved April 2, 1901.*

[Chapter 321.]

An Act relative to the Packing, Inspection and Branding of Fish.

Be it enacted, etc., as follows:

Section 1. Fish intended for sale or exportation, which are now subject to inspection under the provisions of chapter fifty-six of the Public Statutes and of acts in amendment thereof and in addition thereto, may hereafter be packed in any mode agreed upon by the buyer and seller, without inspection or branding, but such fish shall be inspected, if inspection be required, at the time of purchase by the purchaser, who shall in that event pay all expenses of inspecting and repacking.

Section 2. This act shall take effect upon its passage. [*Approved April 24, 1901.*

[J.]

STATISTICS.

The following tables show in detail, by counties, the statistics of the shore net and lobster fisheries of Massachusetts, as reported to this commission. These tables embrace the fisheries with pound nets, weirs,* floating fish traps, fyke nets, seines, gill nets and pots, the latter being used for catching lobsters. They do not, however, include other branches of the shore fisheries, and to that extent fail to be completely comprehensive.

Table No. 1 shows the number of fishermen employed in the various sea-bordering counties in the fisheries designated. It will be seen that Barnstable County has almost half of the fishermen in the State in these special branches of fishery, while the counties of Plymouth, Essex and Dukes are next in importance, in the order named.

Table No. 2 shows, by counties, the number and value of boats, and the number and value of the different forms of apparatus. It will be seen that 830 boats, with a value of $84,479.75, are employed in these fisheries; also 193 pound nets and trap nets, worth $91,605; 1,976 gill nets, seines, etc., valued at $18,893.50; 16,758 lobster pots, worth $21,613.45; and shore property and accessory apparatus, with a value of $13,270.90. The total investment for the State is $229,862.60.

Table No. 3 shows by counties and by species, the quantities and values of the products. These amount to 14,164,249 pounds, with a value, at the prices paid the fishermen, of $314,043.27. Barnstable County leads, with a yield of 7,235,732 pounds, worth $129,321.28. No other county has half this amount of products. In preparing this table, the weight of lobsters was estimated; the actual number of lobsters was 592,179.

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* In the Cape Cod region the pound net and similar contrivances for catching fish are called weirs, although the latter name is a misnomer when applied to pound nets.

TABLE No. 1. — *Showing, by Counties, the Number of Men employed in the Shore Net and Lobster Fisheries of Massachusetts in 1901.*

COUNTIES.	Number.	COUNTIES.	Number.
Essex, ...	116	Nantucket, ...	25
Suffolk, ...	17	Dukes, ...	101
Norfolk, ...	14	Bristol, ...	83
Plymouth, ...	140		
Barnstable, ...	407	Total, ...	903

TABLE No. 2. — *Showing, by Counties, the Apparatus employed in the Shore Net and Lobster Fisheries of Massachusetts in 1901.*

DESIGNATION.	ESSEX.		SUFFOLK.		NORFOLK.	
	Number.	Value.	Number.	Value.	Number.	Value.
Boats, ...	109	$7,197 00	27	$1,645 00	18	$3,010 00
Pound nets and trap nets, .	14	10,550 00	-	-	-	-
Seines, gill nets and fyke nets,	11	525 00	-	-	-	-
Pots,*	3,536	4,192 50	2,288	2,450 50	1,432	2,010 70
Shore property and accessory apparatus, ...	-	897 10	-	178 50	-	224 40
Totals, ...	-	$22,861 60	-	$4,274 00	-	$5,245 10

DESIGNATION.	PLYMOUTH.		BARNSTABLE.		NANTUCKET.	
	Number.	Value.	Number	Value.	Number.	Value.
Boats, ...	154	$9,689 25	329	$38,743 00	29	$4,230 00
Pound nets and trap nets, .	-	-	137	66,125 00	1	400 00
Seines, gill nets and fyke nets,	12	110 00	1,779	13,949 50	148	2,209 00
Pots,*	5,791	8,757 50	1,408	1,598 25	147	133 25
Shore property and accessory apparatus, ...	-	916 20	-	9,913 70	-	30 00
Totals, ...	-	$19,472 95	-	$130,329 45	-	$7,002 25

DESIGNATION.	DUKES.		BRISTOL.		TOTALS.	
	Number.	Value.	Number.	Value.	Number.	Value.
Boats, ...	132	$17,815 50	32	$2,150 00	830	$84,479 75
Pound nets and trap nets, .	41	14,530 00	-	-	193	91,605 00
Seines, gill nets and fyke nets,	1	50 00	25	2,050 00	1,976	18,898 50
Pots,*	1,911	2,190 75	300	280 00	16,758	21,613 45
Shore property and accessory apparatus, ...	-	703 50	-	907 50	-	13,270 90
Totals, ...	-	$35,289 75	-	$5,387 50	-	$229,862 60

* Only lobster pots are included in the classification of "pots."

TABLE NO. 3. — *Showing, by Counties and Species, the Yield of the Shore Net and Lobster Fisheries of Massachusetts in 1901.*

SPECIES.	ESSEX.		SUFFOLK.		NORFOLK.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives,	96,582	$890 00	-	-	-	-
Bluefish,	10	50	-	-	-	-
Flounders and flatfish,	2,670	37 20	-	-	-	-
Mackerel,	195,621	10,059 86	-	-	-	-
Menhaden,	14,141	111 63	-	-	-	-
Pollock,	123,508	1,358 92	-	-	-	-
Salmon,	57	14 25	-	-	-	-
Scup,	465	14 25	-	-	-	-
Sea bass,	-	-	-	-	-	-
Sea herring,	1,380,971	13,157 97	-	-	-	-
Shad,	238	10 90	-	-	-	-
Squeteague,	491	18 75	-	-	-	-
Striped bass,	25	2 00	-	-	-	-
Squid,	2,100	22 00	-	-	-	-
Tautog,	1,466	23 50	-	-	-	-
Other edible or bait species,	351,777	4,104 48	-	-	-	-
Refuse fish,	-	-	-	-	-	-
Lobsters,*.	218,480	22,935 57	105,478	$10,646 22	81,014	$7,640 06
Oil,	-	-	-	-	-	-
Totals,	2,388,602	$52,766 78	105,478	$10,646 22	81,014	$7,640 06

SPECIES.	PLYMOUTH.		BARNSTABLE.		NANTUCKET.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives,	270,000	$4,084 00	1,003,212	$15,173 18	-	-
Bluefish,	-	-	78,947	6,441 96	104,045	$7,962 02
Flounders and flatfish,	-	-	593,339	12,375 81	-	-
Mackerel,	1,126	99 98	741,074	32,013 01	160,876	4,882 16
Menhaden,	3,600	56 00	160,960	380 00	-	-
Pollock,	-	-	819,830	5,665 51	-	-
Salmon,	-	-	15	2 25	-	-
Scup,	-	-	101,511	1,346 07	1,892	76 46
Sea bass,	-	-	2,400	38 00	-	-
Sea herring,	-	-	1,479,341	14,242 04	-	-
Shad,	-	-	2,362	170 81	300	9 00
Squeteague,	-	-	995,800	18,591 32	3,289	116 15
Striped bass,	-	-	23,551	601 42	200	40 00
Squid,	-	-	902,472	7,888 34	644	19 62
Tautog,	-	-	50,042	1,491 96	-	-
Other edible or bait species,	-	-	236,651	6,405 81	16,020	640 80
Refuse fish,	-	-	800	12 00	-	-
Lobsters,	358,661	31,860 62	43,290	6,459 77	3,615	1,030 79
Oil,	-	-	135	22 00	-	-
Totals,	633,387	$36,100 60	7,235,732	$129,321 28	290,881	$14,777 00

TABLE No. 3. — *Yield of the Shore Net and Lobster Fisheries* — Concluded.

SPECIES.	DUKES.		BRISTOL.		TOTAL FOR STATE.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Alewives,	60,715	$565 74	422,516	$4,801 90	1,862,975	$25,514 82
Bluefish,	628	21 98	-	-	183,630	14,426 48
Flounders and flatfish,	70,076	1,811 30	-	-	666,085	13,724 31
Mackerel,	6,654	825 56	-	-	1,104,851	47,880 57
Menhaden,	2,250	19 00	500	15 00	181,451	581 63
Pollock,	148,900	816 00	-	-	1,092,233	7,340 43
Salmon,	-	-	-	-	72	16 50
Scup,	972,993	12,542 99	-	-	1,076,861	18,979 77
Sea bass,	68,800	2,150 73	-	-	70,700	2,188 73
Sea herring,	50	1 00	-	-	2,860,362	27,401 01
Shad,	378	19 25	21,672	1,296 40	25,005	1,506 86
Squeteague,	1,277,082	26,790 63	60	2 40	2,276,672	45,519 25
Striped bass,	1,675	85 15	-	-	25,451	728 57
Squid,	18,200	166 50	-	-	923,416	8,096 46
Tautog,	8,150	120 00	-	-	54,658	1,640 46
Other edible or bait species,	203,994	4,503 94	2,180	163 00	810,622	15,818 03
Refuse fish,	70,000	70 00	-	-	70,800	82 00
Lobsters,	71,207	6,799 50	6,525	703 86	*888,270	88,075 89
Oil,	-	-	-	-	135	22 00
Totals,	2,976,202	$55,809 27	453,453	6,982·06	14,164,249	$314,043 27

* The total number of lobsters taken, as reported to the commission, was 592,179, — a decrease of 10½ per cent. from the catch of the previous year, and a decrease of 24 per cent. in the catch per pot.

PUBLIC DOCUMENT . . . . No. 11.

ANNUAL REPORT

OF THE

BOARD OF HARBOR AND LAND COMMISSIONERS.

FOR THE YEAR 1901.

BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
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1902.

Commonwealth of Massachusetts.

REPORT.

To the Honorable the Senate and House of Representatives of the Commonwealth of Massachusetts.

The Board of Harbor and Land Commissioners, pursuant to the provisions of law, respectfully submits its annual report for the year 1901, covering a period of twelve months, from Nov. 30, 1900.

From Dec. 1, 1900, to Nov. 30, 1901, the Board has held 224 meetings, has given 322 formal and informal hearings, and has received 177 petitions for license to build and maintain structures and for privileges in tide waters and great ponds, to dredge material, to remove material from beaches, and for other purposes.

One hundred and twenty-four licenses for structures and privileges in tide waters and great ponds have been granted during the year; also 37 permits for dredging, for the removal of material from beaches, and for other purposes.

Sixty-five inspections have been made by the Board at various times of work completed and in progress, under appropriations made by the Legislature, in Boston harbor, on the Commonwealth flats at South Boston, the Province Lands in Provincetown, protective works on Connecticut River at Hadley and West Springfield, concrete sea wall on Scituate beach, jetties and channel at West Bay, Osterville, and at Lake Anthony and Menamsha Inlet, Witchmere harbor, Scorton harbor, and location of boundary line between Massachusetts and New Hampshire on Salisbury beach; also of anchorage ground in Boston harbor, proposed location of Northern Avenue and bridge, Ragged Island in Hingham harbor, canal route between Boston harbor and Narragansett

Bay, Stony beach in Hull, Charles River, Merrimac River, Bass River, Herring River, North River, Scussett River, Sandwich harbor, Apponagansett harbor; also of the sites of proposed work in tide water and great ponds, upon petitions and plans presented to the Board, the location of wrecks and obstructions to navigation, and various structures built under licenses from the Board.

Through transactions of the Board there has been paid into the treasury of the Commonwealth during the past year, from rents, licenses, and sales of land, the aggregate sum of $59,751.56.

During the year 11 new contracts* were made by the Board, duly authorized for the estimated expenditure of $152,018.59.

On August 1, the Board executed a bond for a deed of conveyance from the Commonwealth to George C. Corcoran of 31,500 square feet of land on the Commonwealth flats at South Boston, bounded by Anchor, Bullock and D streets, for $15,750, and other considerations of importance and value to the Commonwealth.

On November 26, the Board executed a deed from the Commonwealth to the trustees of the Boston Real Estate Trust of 188,126 square feet of land on the Commonwealth flats at South Boston, bounded by Summer, D, Fargo and E streets, the consideration being $263,376.40. This deed was given in accordance with the provisions of a bond from the Commonwealth to the said trustees, dated Jan. 10, 1899.

COMMONWEALTH TIDE LANDS.

On November 26, a license was granted to the Boston & Maine Railroad to extend Pier 5, Hoosac Tunnel Docks, on Charles River, to the harbor line established by chapter 479 of the Acts of 1897. The Board recommended the payment of $3,615.75 by the licensee for the rights and privileges granted in tide-water land of the Commonwealth to be covered by the proposed extension, and to be used as a dock appurtenant to said extension, the area being 4,821 square feet. This amount was determined by the Governor and Council, Nov. 27, 1901, under section 16 of chapter 19,

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* See Appendix A.

Public Statutes, to be just and equitable. The amount thus received will be paid into the compensation fund for Boston harbor, under chapter 146 of the Acts of 1897, the income of the fund being available for use by the Board in the improvement of that harbor.

BOSTON HARBOR.

The deep and sheltered anchorages in the lower harbor of Boston, together with the safe approaches thereto, entitle it to be classed among the best of natural harbors. The need of deeper channels from the wharves to the sea is an oft-told tale, but it is one which must be repeated and reiterated. They are not the needs of caprice or fancy, as all know, but rest on the solid basis of continued commercial prosperity to the capital city of New England, which is the chief natural outlet for exports from the great north-western territory in vessels of modern type.

In 1892 the federal government, whose duty it is to provide the sea coast harbors with sufficient depth of water ways, in order to enable the ports to meet the growing demands of commerce, approved the project for deepening the main ship channel of Boston harbor to 27 feet at mean low water for a width of 1,000 feet, as far up as the south ferry to East Boston. While this work was under way, it was found that when completed, owing to their greater draft, the channel would be inadequate to the requirements of modern ocean steamships, and consequently other projects were matured and entered on for still greater depths of channel.

In 1899 Congress appropriated $455,000 for the purpose of dredging a new channel from President Roads through Broad Sound to the sea, to be 30 feet deep at mean low water and 1,200 feet wide, and the same is now considerably more than half done.

These projects for improvement, however, failed to keep pace with the increase in the size and depth of the steamships, and still another project was matured, providing for a channel 35 feet deep, and in width varying from 1,200 to 1,500 feet, from the sea up to the Navy Yard and to the first bridges on the Charles and Mystic rivers respectively.

This project passed the lower House of Congress at its last session, but failed in the Senate. It is expected that the same project will be again favorably reported from the rivers and harbors committee, and that an appropriation therefor will be made in the rivers and harbors bill of the Congress now sitting. Every argument and influence in favor of such appropriation should be brought to bear, not only upon our Representatives and Senators at Washington, but also upon all others there having the prosperity and welfare of New England at heart. The voices should never be stilled until our needs in this direction are satisfied.

Within the past decade ocean steamships have grown without precedent in size and capacity. To-day vessels are building for Atlantic carriage with a gross tonnage capacity of 10,000 to 20,000 tons, a displacement from 15,000 to 37,000 tons, and carrying a draft of 28 to 36.5 feet. Among the class referred to, and one of, if not the largest, is the "Celtic," built in 1901. She is 9 feet longer than the "Great Eastern," 1 foot deeper from the same deck, and of 10,700 tons more displacement. Her dimensions, which may somewhat suggest the least extent to which current projects for improving the channels of Boston harbor shall make provision, are as follows: length over all, 700 feet; beam, 75 feet; molded depth, 49 feet; draft when full laden, 36 feet 6 inches; displacement at that draft, 37,700 tons. She can carry 20,900 gross tons, and 2,859 passengers of whom 347 may be first class, at a sea speed of 16 knots.

Economic reasons are the cause which has led to this increase in depth and cargo capacity, and the possibilities of harbor accommodation alone will for some time to come be its limitation. Reduction in the cost of transportation is a constant aim, as is also increase in speed. Both objects are attainable to their extreme limit only by increasing the draft of the vessel proportionately to her length and beam. Consequently, the port that offers the deepest approaches to the wharves will have gained no small advantage.

Other ports are preparing to meet the requirements of these leviathans of the deep, and Boston must not be behind.

At New York the federal government is dredging a channel to the sea 40 feet deep and 2,000 feet wide.

At Liverpool new docks are building, and the sills of others are being lowered.

Bristol, Eng., was granted authority by Parliament at its last sitting to make an expenditure of £2,775,000, or about $13,875,000, for building docks and terminal accommodations at the Avonmouth, with a view of providing not only for the new type of combined cargo and passenger steamships, but for handling a large passenger service, which it is believed her location, favorable to a fast passenger line to Boston, together with quick train despatch of some two hours to London, will justify.

The railroad consolidations lately authorized by the Commonwealth have placed Boston in a position of favorable competition for exports from the great territory naturally her tributary. The railroads themselves have been and are making expenditures freely, to enable them to offer larger facilities and preserve their economic standard of low cost in handling cargoes. The complete separation of passenger and freight service afforded by the new two-storied shed at the Hoosac Tunnel Docks is not only fulfilment of a long-felt want, but an indication of the permanent growth of transatlantic passenger sailings from this port. It is a distinct encouragement to the belief, entertained by not a few, that the advent of the made-up train of Pullmans, awaiting alongside the passenger shed for passengers to enter as soon as the customs examination of luggage is over, that they may be whirled without delay to their homes in the cities of the west, is not far distant. The passenger accommodations at Liverpool and Southampton have shown this side the water how to do it. The tide of passenger travel is setting towards this port, and attention to the greater comfort and convenience of travellers is alone needed to secure a large and permanent passenger patronage.

The Main Ship Channel. — It is now nine years since the project was adopted by the federal government for improving the main ship channel by deepening to 27 feet and widening to 1,000 feet, at an estimated cost of $1,250,000.

It may be interesting to note the progress of the improvement. The annual report of work done in this district under the United States engineers in charge since the first appropriation in July, 1892, shows the following: —

> The amount expended to June 30, 1900, was $825,258.18, all upon improvement. With the amount expended during the fiscal year ending June 30, 1901, the channel 27 feet deep between President Roads and Boston was increased in width 500 feet to the full width of 1,000 feet, excepting for a length of 3,400 feet at the "upper middle," where its width is still only 500 feet; but at the "lower middle" several groups of ledges restrict the available width of the channel to 600 feet. On June 30, 1901, the maximum draft that could be carried over the shoalest part of the improvement was 26 feet at mean low water.

The Broad Sound Channel. — The project was approved by Congress in March, 1899, for deepening the channel through Broad Sound to a depth of 30 feet at mean low water for the width of 1,200 feet, at a cost of $455,000. The work has progressed so that now there is a depth of 30 feet for a width of 775 feet. This channel cannot, however, be made available for use until its approaches have been carefully swept to ascertain if there be any boulders or ledges projecting above the guaranteed depth. As this class of work requires the greatest care and a smooth sea, it will not be done and the new channel buoyed before next summer.

The Thirty-five Foot Channel. — In June, 1900, a survey of the harbor of Boston was authorized by Congress, with a view to provide channels 35 feet deep. A project was reported to Congress in favor of a new channel through Broad Sound into President Roads, 2,000 feet wide and 35 feet deep, to run through the shoals just east of Faun bar. The borings taken in the proposed channel failed to discover any ledge, although one exists just outside which would be dangerous to navigation unless removed. This project included dredging the upper channel to a depth of 35 feet, 1,500 feet wide. Here large quantities of ledge were discovered, which it is estimated will cost $2,371,770 to remove. The total cost of the project recommended to Congress was estimated in round figures at $10,500,000. After suffering a reduction at the hands of the committee of about $2,000,000, the project which passed the House provided for a channel through Broad Sound 1,500 feet wide and through the upper harbor 1,200 feet, with a depth throughout of 35 feet, and authorized the expenditure of $8,000,000, with an appropriation of $3,600,000 available for immediate work.

New avenues of approach need new lights for guidance. Upon completion of the Broad Sound channel, it will have to be buoyed and lighted. To mark the new entrance to the harbor, it becomes necessary to erect a new lighthouse upon or near the Graves, an island or ledge of rocks extending farthest towards Nahant. In order that the new light may be ready to shine as soon as the pathway shall be ready for travel, the Board has communicated with the federal authorities, reciting the needs of the situation, and asking that suitable action may be taken.

ANCHORAGE GROUNDS.

The project presented by the Board in its report last year for the improvement of anchorage grounds between the main ship channel and Bird Island shoal received the sanction of the Legislature by the enactment of chapter 476 of the Acts of 1901. Section 3 of that act requires this Board to obtain from the owners of Bird Island shoal a release of all their right, title and interest therein, without expense to the Commonwealth, before exercising the powers conferred by the act. The title to the shoal is untraceable. It is supposed to have been in the city of Boston, and at the request of this Board the city has executed to the Commonwealth a release of all its right, title and interest thereto. As that release, however, failed to quiet the title, it was thought best to appeal to the Court of Registration for the purpose of having the title of the Commonwealth finally settled. As soon as the question of title is adjusted the Board expects to proceed with the work authorized by the act.

WINTHROP CHANNEL.

Since the dredging of the channel in Winthrop harbor in 1900 there has been a deterioration, and certain shoal spots were found to exist which impeded at extreme low tide the passage of the steamers accustomed to ply between Boston and Winthrop at schedule hours. A survey made in May, 1901, disclosed the nature and the extent of the shoaling, and a contract was subsequently entered into with the Bay State Dredging Company to remove the same to a depth at mean low water of 9 feet, for 29 cents per cubic yard. The work was completed June 7, 2,586 cubic yards of material having been removed, at a cost of $749.94. Thereafterwards the steamers made their daily trips during the season, and no complaint of insufficient depth of water has reached the Board. As the channel is narrow and its sides are high mud flats, it cannot be expected to maintain itself without deterioration, and further dredging from time to time will undoubtedly be required. As this channel is not only a highway of passenger travel to and from Winthrop throughout the summer, but also an increased convenience to boatmen of all classes along that shore, it is deemed by the Board to be worthy of improvement.

SHIRLEY GUT.

In April, surveys were made at Shirley Gut to determine the extent of growth at the end of Point Shirley since the survey of the previous year, and also the amount of excavation required to preserve navigation through the Gut. It was found that the rate of increase of the growth had been the same as for previous years, and it therefore became necessary to make a taking of the end of the point for the purpose of enabling the Board to do the required dredging. On April 23, 1901, a taking was filed in the registry of deeds for the county of Suffolk of about 14,000 square feet of land, above high-water mark and flats lying between it and the Gut. Conferences have taken place with the owners, but as yet the Board has not been able to effect a settlement. Subsequently, about 13,000 cubic yards of material was dredged from the point, thereby excavating the channel to the depth of 12 feet at mean low water. It will presumably be necessary to continue this dredging annually, in order to remove the material deposited on the end of the point by the winter storms.

HULL.

The Board was directed, by chapter 483 of the Acts of 1901, to build such sea walls or other structures in the town of Hull as it may deem necessary for the protection of the outer Boston harbor shore from encroachments or damage by the sea, between Allerton and the retaining wall of the New York, New Haven & Hartford Railroad Company, and authorized to expend for this purpose an amount not exceeding $10,000. This act was approved June 10, 1901, but was not accepted by the town until September 12. Surveys, plans and specifications have been made, contemplating the building of about 1,490 feet of concrete sea wall and about 720 feet of spur jetties; but proposals will not be invited until a more favorable season for the prosecution of the work.

U. S. S. "ENTERPRISE."

Application was received from the Nautical Training School Commissioners, in November, 1900, requesting the Board to dredge a berth for the schoolship "Enterprise," at the North End Park pier. This was accompanied by a statement that no other place could be found for the vessel to lie in, and that the desired dredging was necessary to her safety.

As the proposal was one of an unusual nature, before determining upon the expenditure necessary for the undertaking, the approval of the Governor and Council was requested. That approval having been received, and the permission of the bath trustees of the city of Boston having been obtained, the dock was dredged alongside the bath pier at the North End Park to a depth of 17 feet at mean low water, 45 feet wide on the bottom and 225 feet long, at a cost of $1,000.

THE COMMONWEALTH FLATS AT SOUTH BOSTON.

This tract of land, comprising about 170 acres of filled land, of which about 70 acres lie north of Summer Street and the balance south of it, remains substantially in the same condition as reported last year. The portion south of Summer Street is laid out with streets crossing each other at right angles, and these streets have been raised above the general level of the flats to grade 16, the established grade for streets in this section of the city. It is reached from the city proper by Summer Street, which is a high-grade street, crossing the tracks of the New York, New Haven & Hartford Railroad by a bridge. A large part of the necessary drains and catch-basins for the surface drainage of the territory have been built, and are in good condition.

The principal work done during the year has been on the structures on the borders of this property, which are treated under their respective headings.

A dump for refuse material brought from excavations in the city to be disposed of, has been maintained, but the territory used for this purpose has become so nearly filled that the dump will probably have to be discontinued in the near future; in fact, the available territory for disposing of such material near the business section of the city has nearly all been filled.

A temporary use of various portions of the Commonwealth's property has been made during the year, under permits granted by the Board.

With a view to a beneficial effect upon future sales of this property, it is recommended that the Board be granted power, with the approval of the Governor and Council, to make alterations in plans heretofore adopted, and to alter, discontinue or relocate streets or ways.

The artificial channel through the flats, connecting the coal pockets with deep water, was enlarged in January by dredging, at a cost of $1,000, paid out of the Commonwealth Flats Improvement Fund.

COMMONWEALTH PIER.

Work has been continued on the large new pier at South Boston, now called Commonwealth pier, 1,200 feet long and 400 feet wide, authorized by chapter 513 of the Acts of 1897, which has been under construction during the last four years. The sea wall and filling forming the core or solid portion was completed in 1899, and the oak pile platform, 50 feet wide, surrounding this solid core and forming the face of the pier, in May, 1901.

In order to provide a surfacing material over the clay filling, the Bay State Dredging Company, under a contract dated May 16, deposited on the pier a quantity of coarse gravel of superior quality, for 35 cents per cubic yard. On May 31, a contract was made with Thomas Meany for carting and spreading this material on and adjacent to the pier, for 30 cents per cubic yard. There were 12,656 cubic yards of gravel placed on the pier, and the whole area of Northern Avenue, opposite the pier and adjoining docks, and about one-third of the area of the pier, were covered to the proposed street grade.

On September 6, a contract was made with the Eastern Dredging Company to complete the dredging in the dock on the westerly side of the pier to the depth of 30 feet at mean low water, the work to be completed Dec. 31, 1901, for 22½ cents per cubic yard. Up to December 1, 46,560.4 cubic yards have been removed, and the balance of the work will undoubtedly be completed within the time named in the contract.

The cost of the work, up to December 1, from the appropriation of $400,000, has been as follows: —

For sea wall and filling solid to grade 14,	$215,076 30	
Surveys and supervision,	9,633 69	
		$224,709 99
For construction of pile platform,	$128,069 37	
Surveys and supervision,	2,603 24	
		130,672 61
For dredging westerly dock,	$8,904 68	
Surveys and supervision,	91 00	
		8,995 68
Gravel surfacing,	$8,226 40	
Surveys and supervision,	180 00	
		8,406 40
Total,		$372,784 68

The amount required to complete the work now under contract is estimated to be about $6,600.

A number of applications have been made during the year to use the pier for tying up and discharging vessels, but the inaccessibility of the location from the land has prevented the making of any satisfactory arrangements for permanent use.

Northern Avenue and Bridge.

One step forward was taken during the past year towards securing the necessary additional means of access to the Commonwealth's property at South Boston by the construction of Northern Avenue and bridge, as contemplated by the four-part agreement executed in 1873, under which the Commonwealth, the city of Boston, the Boston Wharf Company and the Boston & Albany Railroad Company began the development of what is now known as the South Boston flats.

Chapter 507 of the Acts of 1901 lays out Northern Avenue, provides for its construction by the city of Boston and for the payment of a portion of the cost thereof by the Commonwealth, as well as for the release by the New England Railroad Company, the successor to the Albany Railroad Company in the ownership of the property, of the land on the South Boston side. The plan of location may be found appended. The act was limited to take effect upon its approval by the city council of Boston. On October 16, the following letter was sent to the mayor of Boston, requesting his early consideration of this matter and its presentation to the city council for action: —

Oct. 16, 1901.

To the Hon. Thomas N. Hart, *Mayor of Boston, City Hall, Boston.*

Sir: — By chapter 507 of the Acts of 1901, the Legislature "laid out Northern Avenue in the city of Boston, from Atlantic Avenue near Oliver Street easterly to Fort Point Channel; thence across said channel by a bridge and thence across lands of the New England Railroad Company and its lessee, the New York, New Haven & Hartford Railroad Company and lands of the Commonwealth."

Northern Avenue would cross the lands of the Commonwealth at South Boston along the water front, connecting the proposed Commonwealth piers, of which the first is now about completed, with Atlantic Avenue and the heart of the city in a direct course at grade.

The act was passed to enable the performance of a prior agreement relating to the filling and improvement of the South Boston flats, whereof the provisions benefiting all the parties thereto except the Commonwealth have been substantially performed.

Under the agreement the benefit to the city has been the creation of land of the present assessed valuation of over $10,000,000, from which the city derives a portion of her taxes, also 100 acres additional remaining to be sold by the Commonwealth, and which will be taxed by the assessors of Boston. Legislation became necessary in order to enable the city and the other parties to honorably fulfil their obligations under the agreement. That fulfilment will give additional value to the Commonwealth's water front, and provide increased facilities for and accommodation to the commercial interests of the port.

These public benefits are in direct connection with the harbor improvements which are so much a matter of public knowledge as to require no comment here. Before the public can gain the advantages contemplated in this act, it must be accepted by the city council of the city of Boston.

The Board of Harbor and Land Commissioners, in behalf of the Commonwealth, and in the public interest, respectfully asks your early consideration of the foregoing, and requests that you may present the matter to the attention of the honorable city council.

For the Board, WOODWARD EMERY,
Chairman.

As yet, final action has not been taken. In the event of a failure to accept the act, further legislation may become necessary.

BULKHEAD AND SEA WALL.

As stated in the report of last year, a contract was made with Augustus Bellevue & Co., on June 1, 1900, to build 1,100 feet of bulkhead for the purpose of partially enclosing the area east of the present filled portion of the South Boston flats, which had already been partially filled by materia dredged in making various improvements on the Commonwealth's property. This work was completed Aug. 20, 1901.

Paid for construction, ...	$12,309 18
Surveys and supervision, ...	559 23
	$12,868 41

The bulkhead is a very substantial structure, and has been reinforced and materially strengthened on its exterior side by broken stone brought from the main channel of the harbor, without cost to the Commonwealth, where it had been blasted in the progress of the work carried on by the federal government for the improvement of the ship channel.

After enclosing the northern side of this area, the Board decided to extend the sea wall on its south side parallel with and 300 feet northerly from the northerly side of the reserved channel; and on March 7, 1901, a contract was made with William J. Lawler, the lowest bidder, to build about 1,350 feet of sea wall, at $56.49 per lineal foot, the work to be completed Oct. 31, 1901. The work was commenced promptly, but, owing to the bad weather encountered in its early stages, the contractor was unable to make the necessary progress with the foundation, and the completion of the work has necessarily been delayed. The foundation is now finished, and the wall proper nearly completed. The amount expended up to December 1 is as follows: —

For construction,	$54,724 06
Surveys and supervision,	1,183 70
	$55,907 76

The amount required to complete the work, including the reserve withheld under the terms of the contract for work already done, is estimated to be $21,600, or about $77,500 in all.

This territory is now so enclosed that the work of filling can be proceeded with at any time; the remaining or easterly side should be enclosed by a bulkhead as the work of filling progresses.

Borings on Area to be occupied by Docks East of the Commonwealth Pier.

Owing to uncertainty as to the area covered by the ledges which were known to exist along the pierhead line near the shoal called Slate Ledge, it was decided to make a series of borings, in order to ascertain the depth and extent of the ledges and the character of material overlying the same.

Work was begun in the latter part of July, and finished early in November. In all, 94 borings were made, covering an area extending easterly from Commonwealth pier about

3,500 feet. The borings were made to the depth of 40 feet below mean low water, unless ledge was found at a higher grade. The bottom was found to consist of silt covering a bed of clay; over and around the ledge was a bed of gravel and clay hard pan, varying from 4 to 10 feet in thickness. In this layer many large boulders were found.

The ledge along the harbor line was found to be above grade 40 feet below mean low water. It begins at a point about 1,300 feet east of the Commonwealth pier, and thence extends easterly a distance of about 1,700 feet, lying southerly from the harbor line on the area which it is proposed to use for piers and docks for 200 to 300 feet; at only a few places, covering a small area, does the ledge rise above a grade of 30 feet below mean low water. It extends a considerable distance out into the harbor, probably being an extension of the ledges found in the main ship channel, which are now being removed by the federal government. Plans have been made showing the location and results of these borings, and are filed for use in designing future structures.

COMMONWEALTH FLATS AT EAST BOSTON.

The claim of the East Boston Company for that portion of its flats taken by the Commonwealth under the provisions of chapter 486 of the Acts of 1897, for the purpose of preserving the public ownership of a portion of the shore front of the port of Boston, remains unsettled, and is pending in the superior court of the county of Suffolk. It is hoped that the case may be tried during the coming year, and the claim finally disposed of.

Following the lease of the Boston & Albany Railroad to the New York Central & Hudson River Railroad Company, — the latter has been enlarging its accommodations by extending docks and piers, under plans approved by the Board, and making other improvements along the south front of East Boston. The new ownership seems to justify anticipations for increased and constant shipments of western freights and cargoes from this port. Boston has now become one of the Atlantic terminals of the New York Central Railroad, with all its ramifications, from which it can make certain classes of shipments more advantageously than elsewhere. Under these conditions, we may fairly expect to see a more extended development of that water front and a demand for larger yards. In order to properly handle its growing business, the tracks should come in at the east end of the water front, and thus serve expansion in the easterly direction, where lies the only opportunity for growth.

A commission has been sitting, under the provisions of chapter 390 of the Acts of 1899, for the purpose of eliminating the railroad grade crossings at many intersecting streets, and it has under consideration plans for removing the railroad tracks which now occupy a strip of land through the centre of the island, and placing them on the east side, contiguous to the water front. While there are obstacles to this plan, they are not insurmountable, and the result would afford ready and accessible railroad accommodations to the water front of more than one-half the island.

The Commonwealth is interested in the final determination of this question, as it now possesses a water front area in this vicinity the development of which depends in a measure upon the location of the tracks in solving the grade crossing problem, and the proceedings of the commission are closely watched by the Board and the Attorney-General.

In this connection it may be well to note the change in the harbor line at Jeffries Point, East Boston, by chapter 419 of the Acts of 1901, whereby an opportunity was created to extend future piers and docks for the berthing of vessels of modern size.

FORT POINT CHANNEL.

Early in the year petitions were received from the owners and tenants of the wharves on Fort Point Channel lying between Congress Street bridge and Rowe's wharf, to have the channel in front of their premises dredged, in order that a class of larger vessels might reach the wharves.

The Edison Electric Illuminating Company, the owner of one of the larger wharves, had already excavated a berth in front of its premises to a depth of 25 feet, for a distance of 60 feet from the harbor line.

The United States government had dredged to a depth of 23 feet the centre portion of the channel for a width of 175 feet from deep water in the harbor up to and through Congress Street bridge; the Commonwealth and the Boston Wharf Company had dredged the space between the government channel and the South Boston shore to the same depth up to the wharves.

After examining the locality, it was decided that dredging to the depth of 20 feet from the government channel to a line 50 feet outside the harbor line on the Boston side would accommodate all the requirements of navigation, and plans and estimates were prepared for this work; and on February 14 a contract was made with the Bay State Dredging Company, the lowest bidder, to excavate this area to the depth of 20 feet below mean low water, the contract price being 25 cents per cubic yard. The work was completed in a satisfactory manner June 3, 1901, at a total cost as follows: —

For dredging, ...	$14,317 25
Surveys and supervision, ...	609 48
	$14,926 73

which was paid out of the income of the harbor compensation fund.

Fort Point Channel originally had a depth of 8 to 9 feet at mean low water in the deepest part of the channel. As business increased and vessels required a greater depth of water, the Commonwealth dredged a channel up as far as Federal Street bridge, to the depth of 16 feet at mean low water. Shortly after, plans were made by the general government to dredge the channel 23 feet deep and 175 feet wide, and an appropriation was made to begin the work. This was expended in dredging up to and through Congress Street bridge. At that time the foundations of the New England Railroad bridge were not carried to a depth sufficient to enable the channel to be excavated to its full depth through that draw, and work was discontinued until such time as new foundations should be put into the railroad bridge. Since then the railroad bridge has been wholly removed, and Summer Street bridge erected substantially on the same location, so that now the work on the government channel can proceed as soon as further appropriation is made. To this end the attention of the federal government has been directed to the change in the situation. This channel is greatly needed, as large steamers are constantly arriving with cargoes which should be discharged at the wharves above Mount Washington Avenue bridge, but are unable to get there on account of the shoal water.

The condition of the bridges on this channel is the same as stated in our last report, except that the construction of the approaches to Cove Street bridge is well under way, notwithstanding the work on the bridge itself, both over the channel and over the tracks of the Boston Terminal Company, has not been commenced.

SOUTH BAY.

By chapter 519 of the Acts of 1897, the Legislature provided for the abolition of the grade crossing at Dorchester Avenue, South Boston. The act directed a commission, to be appointed by the superior court, to "prescribe the details for the abolition of the grade crossing by relocating" certain parts of the Old Colony Railroad. By section 2 the Old Colony Railroad is required to construct a part of the railroad so relocated and connections as prescribed by the commission. It is further provided that the Commonwealth shall pay 20 per cent. and the city of Boston 15 per cent. of the cost.

The commissioners thus appointed heard the parties, and prescribed the locations and construction in a report confirmed by a decree of the superior court. In pursuance of this report and decree, the relocation was made and the construction carried on in the tide waters of the Commonwealth in South Bay. Prior thereto, in December, 1898, the Old Colony Railroad Company filed a petition and plans with the Board of Harbor and Land Commissioners, under the provisions of chapter 19 of the Public Statutes, asking the Board "to authorize such construction and filling, and for such further action in the premises as may be authorized or required by the statutes in such case made and provided." Subsequently, before action by the Board, the petition and plans were withdrawn; the work, however, was performed substantially in accordance with said plans, but without the approval of the Board, the railroad company contending that such approval was rendered unnecessary by chapter 519 of the Acts of 1897, and the doings in pursuance thereof.

The Board contended that this special act did not relieve the railroad company from the provisions of the general statutes, and held that they had displaced tide water by filling therein in South Bay, and thereupon, under the provisions of Public Statutes, chapter 19, section 14, assessed upon them the sum of 15 cents per cubic yard for 115,000 cubic yards of tide water displaced, and claimed that a payment of $17,250 should be made therefor, which claim the Old Colony Railroad Company disputes, and the matter is in the hands of the Attorney-General, to ascertain the legal obligations of the railroad in that respect.

Charles River.

The piers of the new Cambridge bridge across Charles River in the place of the old West Boston bridge are slowly rising above the surface of the water. It will be perhaps two years yet before the bridge will be open to public travel, and the temporary structures removed from the river.

The harbor line on the northerly side of the river between Harvard and Brookline Street bridges was changed by chapter 245 of the Acts of 1901, and made to conform to the line approved by the Secretary of War in 1890, for the purpose of establishing a uniform line along the bank, and the parkway of the city of Cambridge has been continued along the river front, in conformity thereto.

The high flats on the shoreward side of this line, between the end of the existing wall on the east and the Grand Junction Railroad bridge on the west, are being filled with material excavated from the river and deposited behind a temporary wooden bulkhead built to retain the same. In carrying out this improvement a large area of mud flats will have been removed from sight, to a minimum depth of 8 feet below mean low water.

Above Market Street bridge, on the Watertown side of the river, the Metropolitan Park Commissioners have done considerable work in excavating the bed of the river to obtain material for building up the banks in the construction of parkways.

By chapter 411 of the Acts of 1901 the harbor line in front of piers Nos. 6 and 7 of the Hoosac Tunnel Docks was changed, thereby obliterating an angle in the old harbor line, and affording an opportunity for lengthening the dock on the northerly side of Pier No. 7.

During the summer a portion of Pier No. 5, Hoosac Tunnel Docks, was badly injured by fire. In rebuilding the wharf it was extended about 20 feet to the harbor line established by chapter 479 of the Acts of 1897. Owing to the increase in the width of steamers and the narrowness of the dock, 5 feet were cut off from the northerly side of the pier during rebuilding, thus increasing the width of the dock.

CHARLESTOWN DRAWBRIDGE OPENINGS.

On July 1 a letter was received from the city clerk of Boston, requesting approval by the Board, under section 28 of chapter 53, Public Statutes, of the following ordinance passed by the city council of Boston and approved by the mayor June 27, 1901, relating to the hours of opening the draw in Charlestown bridge: —

[ORDINANCES OF 1901, CHAPTER 7.]

AN ORDINANCE RELATING TO THE HOURS OF OPENING THE DRAW IN CHARLESTOWN BRIDGE.

Be it ordained by the City Council of Boston, as follows:

Revised ordinances of 1898, chapter thirty-eight, section three, is hereby amended by inserting in line thirty-four of said section, after the word "tow," the words: — "but he shall not allow any vessel to pass through the draw of Charlestown bridge, so called, except such vessels as shall be ready to go through at the following times: 6.30 A.M., 9.30 A.M., 11 A.M., 12 M., 1.30 P.M., 3 P.M., 8.30 P.M., 11.30 P.M., and from 11.30 P.M. to 6.00 A.M."

IN COMMON COUNCIL, June 20, 1901.

Passed. Sent up for concurrence.

DANIEL J. KILEY,
President.

IN BOARD OF ALDERMEN, June 24, 1901.

Concurred.

JAMES H. DOYLE,
Chairman.

Approved June 27, 1901.

THOMAS N. HART,
Mayor.

A true copy. Attest:

EDWARD J. DONOVAN,
City Clerk.

Public notice was given that the Board would hear all persons interested in the granting or refusing approval of the ordinance above recited, at the office of the Board, on July 8, 1901; and on that date parties in favor of and those opposed to the approval of the ordinance were fully heard. After consideration of the matter, the Board on August 1 took action, as will appear in the following letter: —

BOSTON, Aug. 1, 1901.

A. J. BAILEY, Esq., *Corporation Counsel, Boston, Mass.*

DEAR SIR: — After carefully considering the schedules of the hours for opening the Charlestown bridge for the passage of vessels, as submitted, the Board is not satisfied that there is a sufficient number of openings to meet the requirements of navigation, and therefore cannot give its approval.

The Board respectfully suggests some further inquiry, with a view to ascertaining if the interpolation of another time of opening, between 9.30 and 11 A.M., and two more at a little after 4 and 7 P.M., would not better subserve the interests of navigation without materially increasing the impediment to travel necessarily occasioned by opening the draw; and would draw attention to the consideration that the addition of the three openings suggested would still be two less than the thirteen openings provided by the railroad companies.

Yours truly, WOODWARD EMERY,
Chairman.

MYSTIC RIVER.

There has been no change in the physical condition of this river since the report of last year, beyond the completion of the Malden bridge, in accordance with plans approved by the Board. The draw in the new bridge was made 50 feet wide to accommodate the increasing size of craft.

During the year, claims for displacement by filling on the west side of the river have been made up and put into the Attorney-General's hands for collection. These claims are liable to be contested, on the ground that prior legislation has exempted the owners of flats on that side of the river, within a limited territory, from the payment of compensation for tide water displaced. These contentions raise questions of law which it will be necessary to take to the supreme judicial court for decision, before the rights and obligations of the Commonwealth and the contending parties can be ascertained and settled.

Under the project of the federal government, 86,511 cubic yards of material were dredged below the mouth of Island End River, giving a depth of 25 feet at mean low water in the channel.

The New England Gas and Coke Company have continued their improvements by dredging and the building of structures in Island End River, in accordance with plans approved by the Board. In all they have removed 397,552 cubic yards by dredging in the Mystic and Island End rivers, adjacent to their property.

WEYMOUTH FORE RIVER.

Among the licenses granted during the year, none presages more of benefit and prosperity to the water side of Boston than those permitting improvements and the erection of structures in tide water at the works of the Fore River Ship and Engine Company, on Weymouth Fore River, at Quincy.

Shipbuilding at the port of Boston is reviving. In place of the wooden clipper ships of the last century, we are now building steel vessels of modern type and design. One of the largest and the best-equipped steel ship building plants in the country is rapidly developing on this river, the water of which runs into Hingham bay, with a depth sufficient to float battle ships now building of 15,000 tons and upwards, thence through Nantasket Roads into the main ship channel of Boston harbor.

In order to enable vessels built at the works of this company to pass out of the river, the county commissioners of Norfolk, in rebuilding the Quincy and Weymouth bridge, have provided for two draw openings, each 100 feet in width.

MERRIMAC RIVER.

On October 8, a petition was received from Samuel W. George and other prominent citizens for a relocation and extension of the harbor line on the northerly side of the Merrimac River, in Haverhill, "to such an extent and in such manner as the Board may deem necessary to meet the requirements of business and public interests."

Pursuant to the provisions of law, the Board caused notice to be published, and on November 21 gave a public hearing in the city hall in Haverhill to the petitioners and all persons who desired to be heard on this subject.

The present harbor line was established by chapter 104 of the Acts of 1883, but, owing to the growth of business and changes in local conditions, the petitioners wish to have a new line established which will permit the erection of structures farther into the river, and at the same time give an opportunity for building a quay or bulkhead in water of sufficient depth to float a loaded barge or vessel.

It is recommended that a new harbor line be established, in accordance with a plan on file in the office of the Board.

CONNECTICUT RIVER.

In the spring of the year willow cuttings were planted in the banks of the river, where they were protected by the riprapping done during the previous year, that being a stretch of about 1,269 feet to a point nearly opposite the old Amherst road, running past the Hadley Almshouse. The willows are expected in this case, as heretofore, to spread their roots and form a solid network, thus holding in place the riprapping, and forming a perfect protection against the action of the current, waves and ice.

The river was inspected during the great freshet in April, when it rose as high or higher than at any time during the past thirty years; apparently no wind accompanied the freshet, and but little damage was done. No injury was occasioned to the banks where they had been protected under prior appropriations by the Legislature.

Later, the selectmen of Hadley were given authority to repair any injury to the banks within their town which have been protected through the agency of the Commonwealth.

In July, the Board, in pursuance of the authority and appropriation granted by chapter 94 of the Resolves of 1901, made a contract for protecting the banks at Hadley, from the end of the work done last year to a point near the mouth of Coleman's Brook, and employed E. C. Davis of Northampton to superintend the work. During the season the members of the Board, with the engineer, made inspections of the work while it was progressing and upon its completion. The work was satisfactorily accomplished under the same method as had theretofore been successfully adopted, and was completed November 5.

The section of river bank treated this year extends from the northerly end of last year's work up the river to Coleman's Brook, — a distance of 1,455 feet. The area covered by the mats and riprapping is 19,989 square yards, at a cost of 53⅓ cents per square yard, making a total cost for the entire work, including surveys, plan and estimate for proposed dike below the highway, of $10,660.78.

Owing to some favorable circumstances, and the personal qualifications of the overseer in charge of the work, a considerable reduction in the cost per square yard of last year's work, which was 69$\frac{7}{10}$ cents, is noticeable.

The completion of the protective works from the head of Front Street in Hadley around the "high banks," so called, to Coleman's Brook, includes a distance of 5,100 feet, or nearly a mile, and will in the future afford protection to the main part of the town from further encroachments of the river.

No other portion of the river bank in the town is exposed to the influences which have hitherto encroached upon the land now thoroughly protected; and no danger need be apprehended except from a small break below the highway, which will have to be protected by a dike, for which plans and estimates have been made, and the cost of which will be well within the unexpended balance of the appropriation already made.

In the prosecution of the work it became necessary to purchase some equipment, in the nature of scows, which could not be hired, together with tools and material, for which there is no further need; and it is recommended that authority be given the Board to sell such things after the entire work is completed, and turn the proceeds in to the treasury of the Commonwealth.

The unexpended balance of the appropriation now available is $7,728.01.

The report* of the engineer in charge may be found in the Appendix.

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* See Appendix B.

NEW BEDFORD AND FAIRHAVEN BRIDGE.

It will be remembered that chapter 99 of the Resolves of 1899 constituted the Board of Railroad Commissioners and the Board of Harbor and Land Commissioners a joint Board for the purpose of investigating and reporting upon the subject of relocating and widening the New Bedford and Fairhaven bridge over the Acushnet River.

The joint Board made its report to the Legislature, (House, No. 278) on Jan. 22, 1900. The Legislature adopted the report, and, by chapter 439 of the Acts of 1900, constituted the said commissions a joint Board to prescribe the manner in which so much of the highway, bridge and approaches as remained to be completed should be constructed, and to approve all plans, specifications and requirements necessary to finish the undertaking.

As stated in the report of last year, the joint Board, under the provisions of chapter 439 of the Acts of 1900, approved the contract and specifications for building a temporary bridge, and also removing the old bridge.

On Jan. 25, 1901, after hearings, duly advertised, at which all persons interested had an opportunity to appear before the Board and be heard upon all matters pertaining to the completion of the bridge under the provisions of chapter 439 of the Acts of 1900, the following order was passed: —

ORDER.

COMMONWEALTH OF MASSACHUSETTS.

In Joint Board of the Board of Railroad Commissioners and the Board of Harbor and Land Commissioners of the Commonwealth.

In Re RELOCATION AND COMPLETION OF THE BRIDGE OVER THE ACUSHNET RIVER BETWEEN THE CITY OF NEW BEDFORD AND THE TOWN OF FAIRHAVEN.

Board of Railroad Commissioners: Hon. James F. Jackson, chairman; George W. Bishop; Hersey B. Goodwin. Board of Harbor and Land Commissioners: Hon. Woodward Emery, Chairman; Clinton White; Charles C. Doten. Hon. Woodward Emery, chairman of joint Board.

At a meeting of the Board of Railroad Commissioners and the Board of Harbor and Land Commissioners, sitting as a joint Board by virtue of the authority of chapter 439 of the Acts of the year 1900, at which all the members were present, held this twenty-fifth day of January, 1901, it was adjudged as follows, to wit: —

Whereas, by act of the Legislature, Resolves 1899, chapter 99, it was "*Resolved*, That the Board of Railroad Commissioners and the Board of Harbor and Land Commissioners, who are for this purpose constituted a joint Board to act by a majority vote of all the members thereof, are directed to consider the matter of the completion of the New Bedford and Fairhaven bridge over the Acushnet River, and to report to the next General Court, on or before the fifteenth day of January, what has been the expense of said bridge as far as constructed; also to report how and in what manner the bridge and the approaches thereto on the New Bedford side should be completed, including the abolition of any railroad grade crossing, the probable expense thereof, and by whom the work should be done, and by what parties the expense should be borne and paid; and that no contracts be made by the county commissioners of Bristol County in respect to said bridge until authorized by the General Court";

And whereas, in pursuance of said resolve, the said joint Board made a report to the Legislature, as follows, viz.: —

COMMONWEALTH OF MASSACHUSETTS.

REPORT OF THE JOINT BOARD UPON THE SUBJECT OF RELOCATING AND WIDENING THE NEW BEDFORD AND FAIRHAVEN BRIDGE OVER THE ACUSHNET RIVER.

To the Honorable the Senate and House of Representatives of the Commonwealth in General Court assembled.

By chapter 99 of the Resolves of 1899, the Board of Railroad Commissioners and the Board of Harbor and Land Commissioners were constituted a joint Board for the purpose of investigating and reporting upon the subject of relocating and widening the New Bedford and Fairhaven bridge over the Acushnet River. The resolve reads as follows: —

RESOLVE TO PROVIDE FOR AN INVESTIGATION BY THE BOARD OF RAILROAD COMMISSIONERS AND THE BOARD OF HARBOR AND LAND COMMISSIONERS RELATIVE TO THE RELOCATING AND WIDENING OF THE OLD BRIDGE OVER THE ACUSHNET RIVER BETWEEN THE CITY OF NEW BEDFORD AND TOWN OF FAIRHAVEN.

Resolved, That the board of railroad commissioners and the board of harbor and land commissioners, who are for this purpose constituted a joint board to act by a majority vote of all the members thereof, are directed to consider the matter of the completion of the New Bedford and Fairhaven bridge over the Acushnet river, and to report to the next general court on or before the fifteenth day of January, what has been the expense of said bridge as far as constructed; also to report how and in what manner the bridge and the approaches thereto on the New Bedford side should be completed, including the abolition of any railroad grade crossing, the probable expense thereof, and by whom the work should be done, and by what parties the

expense thereof should be borne and paid; and that no contracts be made by the county commissioners of Bristol county in respect to said bridge until authorized by the general court. [*Approved June 2, 1899.*

The joint Board published notices in sundry newspapers, in order to give all persons interested an opportunity to be heard, and gave hearings at the office of the Railroad Commissioners in Boston. They also personally pursued inquiries and made investigations. In a body they inspected the locality of the proposed bridge at New Bedford, and all places in the vicinity which might tend toward aiding in a solution of the questions involved.

The interests to be affected were represented by eminent counsel, who laid before the joint Board the history of proceedings relative to the bridge from its inception; presented the points of view and the interests both of public and private nature involved in the undertaking, and prepared and argued elaborate printed briefs in support of their contentions. Stenographic reports of the hearings before the legislative committee of last winter, and of a hearing before the Grade Crossing Commissioners, appointed prior thereto, were placed in the possession of the Board, and freely referred to.

After fully hearing all desiring to be heard and carefully considering the questions presented, the joint Board unanimously concur in answering the questions submitted to it by the Legislature as follows: —

I. *With Reference to the Expense of said Bridge as far as constructed.*

The treasurer of the county of Bristol reports that the whole amount expended on account of the New Bedford and Fairhaven bridge from the first itemized charge in 1894 down to Jan. 1, 1900, is $810,932.30. This sum includes: —

The construction account of the bridge proper, . . .	$632,078 09
The land damage account, ...	129,854 21
The interest on county notes, ...	49,000 00

II. *How and in what Manner the Bridge and the Approaches thereto on the New Bedford Side should be completed, including the Abolition of any Railroad Grade Crossings.*

The Board did not consider this as a purely grade crossing question, but as one involving the proper approaches of an expensive highway bridge, 70 feet wide, with some attempt at architectural effect, and realized that it should be studied with reference to its having been already more than half built, and to its being finished with some regard to the wishes of the community upon whom would fall a large part of the burden of paying for it.

In this deliberation, the existence of a steam railroad crossing, with its necessarily attendant dangers and inconveniences, was an essential factor.

A brief review may aid in comprehending the present situation. An ancient highway, 30 feet in width, crossed the Acushnet River between the town of Fairhaven and the city of New Bedford by a bridge and over the intervening Pope's and Fish islands. On the New Bedford side this highway was intersected by the tracks of the Old Colony Railroad at grade, in the year 1873, and trains for passengers and freight have since passed and repassed along the water front of the city daily, at frequent intervals intercepting public travel over the highway.

The Union Street Railway was granted a location in the highway in 1872, and has since operated its cars therein and across the Old Colony Railroad, at grade.

In May, 1893, by chapter 368 of the Acts of that year, the Legislature authorized the county commissioners of Bristol County to rebuild the bridge between New Bedford and Fairhaven, and limited the expense thereof to $200,000. The same act also authorized the commissioners to construct the approaches at a common grade with the railroad, should they deem it advisable, or to require the mayor and aldermen of New Bedford to institute proceedings under the grade crossings act, chapter 428 of the Acts of 1890, when the question would be left to the commission appointed by the superior court.

Under the authority of the act of 1893, the county commissioners caused plans to be made for both a grade and an overhead bridge. In 1894, by chapter 239 of the Acts, the Legislature authorized an increased expense of $150,000, thereby limiting the cost to $350,000, which was to be exclusive of land damages; and, upon petition of the citizens of Fairhaven and Acushnet, by chapter 530 of the Acts of that year, allowed a change in the eastern terminus of the bridge.

From 1894 to 1896 various plans were proposed for the abolition of a number of grade crossings in New Bedford, including the Bridge Street crossing, but the city and railroad were unable to agree on any plan.

On July 11, 1896, the county commissioners, after a number of hearings, decreed that in their judgment the public convenience and necessity required that the bridge should be constructed at grade with the railroad. In August, 1896, the commissioners awarded a contract for construction between Fairhaven and Fish Island, according to plans approved and decreed by them. At that time they were authorized to expend only $350,000, exclusive of land and other damages. During the winter of 1896 and 1897, it was found that the appropriation heretofore made was insufficient, and the Legislature was asked to authorize an additional amount, which was given by chapter 200 of the Acts of 1897, making the total $450,000.

During that year, owing to the requirements by federal authority for a draw with two openings, of 100 feet each in width, the county commissioners found that they would be unable to complete the bridge as they had planned (at grade) for the amount allowed by the Legislature, and asked for authority to spend more money. By chapter 387 of the Acts of 1898 they were authorized to expend for the total construction of the bridge, without damages, $800,000, thereby increasing the original authority $600,000, or 300 per cent. The same act would seem to confirm the action of the county commissioners in laying out the bridge at grade with the railroad. The original decree of July 11, 1896, established the bridge at grade across Fish Island; but by a decree of the commissioners, May 23, 1898, following the fixed elevation of the draw, a new grade was determined, by which the roadway was raised an average of 7½ feet across the island.

In January, 1899, a bill was presented to the Legislature, making it mandatory upon the county commissioners to construct the bridge and approaches thereto on the New Bedford side over the tracks, providing that the western approach should not be farther west than Acushnet Avenue, and that the difference in cost above that for a grade bridge should be apportioned under the grade crossing act of 1890. Said difference in cost would amount, for construction and including damages, probably $700,000, making the total cost about $1,500,000; and of this extra cost it was proposed to apportion 25 per cent. on the Commonwealth, 65 per cent. on the railroad and the balance on parties benefited, as provided in the original act.

Various amendments were proposed to this act, and toward the end of the session a new bill (Senate, No. 337) was proposed, which authorized the superior court to appoint a commission who were to have power to say whether the bridge should be built overhead or at grade, and to apportion the cost upon the Commonwealth, the railroad and the city. This bill was rejected, and the whole subject of completing the bridge was placed in the hands of the joint Board of Railroad Commissioners and Harbor and Land Commissioners, to report to the Legislature their findings.

A careful study of the legislation and the testimony submitted would seem to indicate that it was not the original intention to build such a structure as has already been erected, and the amount of money so far expended is far in excess of what public convenience and necessity required. At present, however, there exists a very expensive structure, now partially completed; and the citizens of New Bedford are not satisfied that the bridge shall end as was originally intended, but wish to have it carried farther into the city. This local sentiment is strong. It was apparent at the hearings before the joint Board, where, in the brief of counsel, it was suggested that the city was ready to bear an unusual portion of the expense pertaining to the overhead structure. Recent acts of the city council of New Bedford confirm this attitude.

The railroad crossing at the western location of the bridge is an extension from the New Bedford depot to the wharves, for the purpose of reaching their steamboat connections and to carry freight to and from private wharves, and is not used by express trains, and in this respect may be differentiated from the more important grade crossings on main lines. The danger, however, at this particular crossing is emphasized by the existence of an electric railway, which has practically secured an exclusive right of way across this bridge, and promises to become the New Bedford end of a growing system.

With this situation facing us, a difficult problem is presented. Danger is a word of as uncertain significance as there are minds to be affected by it. Few would have the hardihood to deny its existence at this crossing, or that with the passage of time and the growth of population and business it would not materially increase, even if minimized for the present by restrictions and regulations.

The policy of the Commonwealth as to the separation of grade crossings is firmly established, as is its rule against permitting electric railways to cross steam railways at grade whenever it can be avoided. The large number of occasions in which, from various causes, electric cars become stalled while crossing steam railroad tracks, may be cited as testimony in confirmation of the wisdom of this rule. For this reason the Legislature has passed an act authorizing electric railway companies to take land for the purpose of constructing bridges over or ways under railroad locations.

In view, then, of the existence of a partially constructed bridge of magnificent proportions; of the strong sentiment in and demand of New Bedford that it shall be finished as an overhead structure across the railroad tracks, and avoiding Bridge Square as a terminal; of the existence of danger and inconvenience of a public grade crossing at this place; and of the added peril by reason of the presence of an electric railway, promising to be double tracked and the end of a system in the near future, — the joint Board has finally reached the unanimous conclusion to recommend the abolition of the public grade crossing at Bridge Street, and the construction of an overhead bridge. This will unavoidably leave a *private* crossing for the abutters between the railroad and the river, which will have to be preserved *as are the other private* crossings further to the south, and to this extent will prevent *the entire elimination of this grade crossing.*

III. As to the Probable Expense thereof.

It was early seen that the expense of carrying an overhead bridge structure, with proper approaches, into the city of New Bedford, would be very great. It was fully recognized that the expenses thus far incurred are in many quarters deemed most lavish and extravagant, have become a subject of general comment and stricture, and excited apprehension on the part of tax payers; and that the city of New Bedford, however much her citizens might desire to have this work carried out to completion on the scale upon which it had begun, could not disregard the fact that she already was burdened with a heavy tax rate.

Several plans were presented to the joint Board. One contemplated beginning at the east side of Fish Island, and ending at Second Street. Two other plans were shown, — one more and one less expensive to build. The first of these latter plans would involve the payment of additional grade damages on Fish Island, and a large amount on the New Bedford side. This was urged, as affording the finest approach into the city of New Bedford, as comporting with the dignity and character of the entire bridge structure, and as creating an opportunity for advantageously widening adjacent streets and furnishing a boulevard for the embellishment of the city. Estimates were given of the cost at from $642,000 to $750,000. It seemed to the Board that something satisfactory from the esthetic as well as the utilitarian point of view could be accomplished at considerably less cost; and after due deliberation it was concluded that an elevated structure, 70 feet wide, to begin at the west side of Fish Island, and rising at a grade of less than 3 per cent. to an elevation over the railroad track that would give 16 vertical feet in the clear for car space underneath, and thence descending, by a grade not to exceed 3 per cent., to Water Street, would meet and fulfill all the requirements of the situation.

As no appropriation for furnishing the Board with the services of an expert bridge engineer to deal with this purely technical problem of architectural engineering had been provided, the joint Board was obliged to rely largely upon gratuitous advice and assistance in making this estimate.

The joint Board is of opinion that the total expense, including land and grade damages, of completing the way as already laid out across Fish Island, and of constructing an overhead bridge, beginning at the western end of Fish Island, crossing the channel and the railroad and landing at Water Street, ought not to exceed the sum of $450,000. This estimate, while large, is not calculated to provide for any further payments of damages excessively disproportionate to assessed valuation.

IV. By whom should the Work be done?

In view of the extravagant expenditure of public money by the county commissioners, and the fact that the remaining portion of the bridge to be built is within the limits of New Bedford, it seems proper to suggest that city as the most fitting and suitable party to proceed with the completion of the undertaking. It is for her interest that it should be done as economically as may be, for on her will fall a great part of the burden. She will also be better able to provide for and adjust the approaches through her streets to meet the termination of the bridge proper within her limits.

The railroad company disclaims any desire to build that portion of the structure to be erected within the lines of the railroad location, but is willing that it should be done by the city. Furthermore, the other parties interested will be watchful for careful and economical expenditures.

It is accordingly recommended that the city of New Bedford be the party by whom the work should be done.

V. By what Parties the Expense thereof should be borne and paid.

In view of all the foregoing and of the peculiar conditions which exist, and of the unusual character and proportions of the bridge, and also of the fact that a *private crossing with its attendant expense and dangers is left for the railroad company to deal with as best it may*, it is obvious that it would be unjust to expect the Commonwealth and the railroad company to pay more than an equitable proportion of the cost of abolition. Such deviation from the grade crossing act of 1890 has been recognized when special conditions have called for apportionment of cost adapted to the peculiar circumstances of the case.

The city of New Bedford presents no claim to be exempt from bearing her full share of a great improvement, from which, more than all other parties, she will derive benefit and satisfaction.

The Union Street Railway Company would be the recipient of benefits from the proposed elevated structure that would justify charging to it a portion of the expense thereof. The Union Street Railway Company has secured privileges from New Bedford, Fairhaven and the county commissioners, with a view of being confirmed in exclusive occupation of this bridge with its railway. Without discussing the scope or validity of these privileges, there is little doubt of a continuance of its possession of an exclusive location over the bridge. Street railway accommodation is needed, and so long as it is given by this company it is not likely that any disturbance of occupation will take place. The bridge was widened in order to give space for the tracks of the railway without incommoding other traffic.

The Legislature has recognized by general laws and by special enactments the propriety of imposing upon street railways, under special conditions, a portion of the expense of public improvements by which they were particularly to be benefited.

The joint Board feels justified, in this case, in recommending that the Union Street Railway Company be assessed a fair percentage of the cost of all the New Bedford end now remaining to be built.

The town of Fairhaven would receive a distinct, special benefit from its abolition, and therefore should bear a part of the expense.

The expense already incurred in building the bridge from the Fairhaven shore to Fish Island is too great to justify the suggestion that any towns in Plymouth County be charged with a contribution larger than is limited by chapter 460 of the Acts of 1899.

While the resolve does not in words require a report on the proper apportionment of the expense upon the parties by whom it should be borne and paid, nevertheless, considering the true purpose and intent of the resolve, it is believed that the report would be considered incomplete unless a recommendation to that effect were included. Indeed, to fix the proportions is but a step beyond discriminating the parties.

The joint Board has estimated that an expense of completing the bridge, in the manner hereinbefore recommended, by an overhead structure, ought not to exceed $450,000. The estimate of $220,000 for completing the bridge at grade has been given by other reliable authority. The difference between these two amounts, that is, the sum of $230,000, would seem, then, to be properly chargeable to the overhead structure, and to be the sum fairly to be apportioned by this report. As, however, this sum is but an estimate, and liable to variation, it is recommended that the expense of that portion of the bridge under consideration, whatever it may ultimately be found to be, shall be divided and paid as follows: —

The Commonwealth to pay 12 per cent., in no event to exceed	$30,000
The New York, New Haven & Hartford Railroad to pay 33 per cent., in no event to exceed	90,000
The Union Street Railway Company to pay 10 per cent., in no event to exceed	25,000
The town of Fairhaven to pay 5 per cent., in no event to exceed	12,500
The city of New Bedford to pay the balance.	

The sum of $220,000 which is the estimate for finishing the bridge at grade is left to be apportioned under the terms of the original bridge act.

It is further suggested that any bill drafted in pursuance of these recommendations should contain provision to secure an application of the betterment law in all suits brought for damages to private property.

WOODWARD EMERY, *Chairman*,
JAMES F. JACKSON,
GEORGE W. BISHOP,
HERSEY B. GOODWIN,
Board of Railroad Commissioners.
CLINTON WHITE,
CHARLES C. DOTEN,
Board of Harbor and Land Commissioners.

And whereas, by chapter 439 of the Acts of the year 1900, entitled "An Act relative to the relocation and completion of the bridge over the Acushnet River between the city of New Bedford and the town of Fairhaven," it was enacted as follows, viz.: —

SECTION 1. The board of railroad commissioners and the board of harbor and land commissioners, who for this purpose are constituted a joint board to act by a majority vote of all the members thereof, shall prescribe the manner in which so much of the highway, bridge and the approaches thereto, between the city of New Bedford and the town of Fairhaven, as has not been constructed by the county commissioners of the county of Bristol, under the provisions of chapter three hundred and sixty-eight of the acts of the year eighteen hundred and ninety-three, and all acts in amendment thereof and in addition thereto, shall be constructed and completed, and, except as herein otherwise provided, maintained by the city of New Bedford, from the east side of Fish Island to the east line of Water street, *in accordance with the recommendations* and *report of said joint board* to the general court of the year nineteen hundred, and *in accordance with plans, specifications and requirements to be adopted and approved by said joint board, and by them duly filed in the registry of deeds for the county of Bristol, southern district;* and said city in the construction and completion thereof, as thus prescribed, shall exercise all the powers and perform all the duties pertaining thereto imposed upon said county commissioners by said acts, not inconsistent therewith.

SECTION 2. The city of New Bedford is hereby authorized and directed to locate and lay out anew said bridge and the approaches and way leading thereto, *in the manner prescribed by said joint board*, and to take therefor, by purchase or otherwise, the private property of persons and corporations, as provided in section four of chapter three hundred and sixty-eight of the acts of the year eighteen hundred and ninety-three, in relation to the taking of lands by the said county commissioners. All proposals for bids for the construction of the whole or any portion of said bridge by said city shall be expressed therein, to be subject to the right of said city to reject any and all bids not approved in writing by said joint board.

And whereas, due notice was given to all parties interested by said joint Board, of the time and place of hearing, at which time and place the city of New Bedford was represented by the Hon. Charles S. Ashley, mayor of the city of New Bedford, William F. Williams, city engineer, and Thomas F. Desmond, special counsel for said city; the Old Colony Railroad Company by the Hon. J. H. Benton; the Union Street Railway Company by the Hon. C. W. Clifford and Oliver Prescott, Jr., Esq.; the owners of Parker's block by said C. W. Clifford; the firm of Garfield & Proctor by said C. W. Clifford; and the firm of Anthony, Swift & Co. by Freedom Hutchinson.

Now, therefore, after due notice to all parties interested, and hearing given to all parties interested, present and desiring to be heard; it was unanimously —

Voted, That we, the Board of Railroad Commissioners and the Board of Harbor and Land Commissioners, sitting as a joint Board, in pursuance of the provisions of chapter 439 of the Acts of the year 1900, do hereby "prescribe the manner in which so much of the highway, bridge and the approaches thereto, between the city of New Bedford and the town of Fairhaven as has not been constructed by the county commissioners of the county of Bristol under the provisions of chapter 368 of the Acts of the year 1893, and all acts in amendment thereof and in addition thereto, shall be constructed and completed, and, except as otherwise provided by chapter 439 of the Acts of the year 1900, maintained by the city of New Bedford from the east side of Fish Island to the east line of Water Street, in accordance with the recommendations and report of the joint Board to the General Court of the year 1900," as follows: —

I. We prescribe the construction of an overhead bridge from the east side of Fish Island to the east line of Water Street in the city of New Bedford, in the manner hereinafter provided, but upon the condition that there shall be reserved upon and over the location and tracks of the railroad company, for the benefit of the estates abutting upon Bridge Street between the railroad and the river, an open crossing at grade, free from the obstruction of gates or bars, to be planked and maintained by the railroad company for the time being in possession.

II. We prescribe that the existing way leading from the river to Bridge Square, except as to that portion within the location of the railroad, shall be forever maintained and kept in repair by the city of New Bedford as an approach to the bridge for the benefit of the estates abutting thereon; and that the bridge over said existing way shall be constructed with due regard to convenient access for ordinary traffic to and from the abutting estates, in accordance with the plans and specifications for building the bridge approved by the joint Board.

III. We prescribe the construction and completion of so much of the highway, bridge and approaches thereto between the city of New Bedford and the town of Fairhaven as lies between the east line of Water Street and the east side of Fish Island upon and over the following described location, viz.: the north line begins at a point in the east line of Water Street seventy (70) feet northerly in said east line from the north line of Middle Street, thence easterly in a straight line parallel to and seventy (70) feet distant from the north line of Middle Street, one hundred fifty-six and seven hundredths (156.07) feet; thence in a curve whose radius is fifty (50) feet and angle of intersection twenty-one degrees, thirty-three minutes, fifteen seconds (21° 33′ 15″) to the north, eighteen and eighty-one hundredths (18.81) feet; thence in a straight line tangent to said curve, sixty-two and three hundredths (62.03) feet to a boundstone called "number one" in the New Bedford bridge decree of the county commissioners of Bristol County, dated July 11, 1896; thence in a continuation of the same line easterly one hundred fifty-two and nine tenths (152.9) feet to a boundstone called in said decree "number two," in the east line of the location of the Old Colony Railroad; thence deflecting to the south four degrees fifty-one minutes (4° 51′) and in a straight line five hundred nineteen and fourteen hundredths (519.14) feet to a point in the west shore of Fish Island; thence deflecting to the north one degree six minutes (1° 6′) and in a straight line four hundred forty-seven and ninety-six hundredths (447.96) feet to the east face of the parapet of the present masonry abutment on the east shore of Fish Island; thence southerly across the bridge in the line of the face of said abutment seventy (70) feet; thence the southerly line runs westerly in a straight line parallel to and seventy (70) feet distant from the above-described north line, four hundred forty-eight and sixty-three hundredths (448.63) feet; thence deflecting to the north one degree six minutes (1° 6′) and in a straight line parallel to and seventy (70) feet distant from said north line, five hundred sixteen and eighty-five hundredths (516.85) feet; thence deflecting to the south four degrees fifty-one minutes (4° 51′) and in a straight line parallel to and seventy (70) feet distant from the above-described north line, one hundred forty-nine and ninety-four hundredths (149.94) feet to a point at right angles to boundstone number one; thence continuing in the same line eighty-four and eighty-six hundredths (84.86) feet to a point in the north line of Middle Street; thence westerly in the north line of Middle Street one hundred seventy-nine and four hundredths (179.04) feet to the east line of Water Street; thence northerly in the east line of Water Street seventy (70) feet to the point of beginning.

So much of the above described location as lies east of boundstone "number one," aforesaid, being in exact conformity to the location as described by the said decree of the county commissioners, and all the metes and bounds thereof being the same as established by said decree, that part of said location lying west of said boundstone "number one" shall be taken and laid out by the city of New Bedford, under the provisions of chapter 439 of the Acts of 1900.

IV. We prescribe the grades at which the bridge and the approaches thereto shall be constructed to be as follows, to wit: the grade of the surface of the pavement on the middle line thereof shall begin at the New Bedford approach on the east line of Water Street at an elevation of ten and ninety-four hundredths (10.94) feet above the New Bedford city base; thence the grade runs by an ascending grade easterly not exceeding three (3) feet per one hundred (100) feet for three hundred seventy-eight and twenty-eight hundredths (378.28) feet to elevation twenty-two and three tenths (22.3) feet; thence in a vertical curve whose highest elevation is twenty-two and thirty-five hundredths (22.35) feet, a distance of eleven and seventy-five hundredths (11.75) feet to elevation twenty-two and three tenths (22.3) feet; thence by a descending grade of three (3) feet per one hundred (100) feet, ten (10) feet to elevation twenty-two (22) feet; thence by a descending grade of two and twenty-one hundredths (2.21) feet per one hundred (100) feet, four hundred seventy-nine and fifty-six hundredths (479.56) feet to elevation eleven and four tenths (11.4) feet; thence by a vertical curve a distance of eighty (80) feet to elevation ten and seventy-seven hundredths (10.77) feet on the west shore of Fish Island, which is the elevation established by the decree of the county commissioners dated May 23, 1898, as the grade of the bridge at this point; thence by the grade established by said decree of May 23, 1898, which is an ascending grade of six hundred sixty-nine thousandths (.669) of a foot per one hundred (100) feet, to elevation thirteen and five tenths (13.5) feet at the face of the parapet of the present abutment on the east side of Fish Island. The grade of the northerly and southerly curbs of said approaches and bridge are the same as above described for the surface of the pavement at the middle line of said approaches and bridge, except where it may be necessary to modify them in order that the curbs may be at the same elevation on opposite sides of the roadway. The grade of the top of the coping of retaining walls and the top of the fascia of metal work is three (3) inches above the grade of the curbs.

The grade of that portion of the surface of the ground within the lines of the bridge location and beneath the metal work of the overhead bridge, from the abutment near the west line of Front Street to the abutment on the New Bedford shore, shall be as follows: beginning at the east face of said abutment near the west line of Front Street at an elevation of five (5) feet above said city base, thence easterly by a descending grade to elevation four (4) feet at the west line of the location of the Old Colony Railroad, which is the present elevation of the tracks of said railroad; thence across said location at a level grade; thence easterly from elevation four (4) feet at the east line of said location by an ascending grade to an elevation of five (5) feet at the west side of the New Bedford shore abutment.

The location and grades of said bridge and approaches are shown on a plan verified by the signatures of the joint Board, entitled "Location and grades of the New Bedford and Fairhaven bridge."

V. We prescribe that said highway, bridge and approaches as above described shall be constructed within the location and at the grades above described in the manner following: —

First. — That portion thereof from the east line of Water Street easterly for a distance of one hundred eighty-four and thirty-one hundredths (184.31) feet, measured on the centre line of said location, shall have masonry retaining walls on the north and south lines and a masonry abutment at the easterly end, the space within said walls and abutment to be filled solid with suitable filling.

Second. — That portion from the abutment just described to an abutment forty (40) feet west of the west shore of Fish Island shall consist of a bridge or metal superstructure of thirteen (13) deck spans of steel plate girders resting on three (3) masonry piers, three (3) masonry abutments and thirty-two (32) steel posts. That portion thereof over the location and tracks of the Old Colony Railroad Company shall be constructed so as to provide a clear height of sixteen (16) feet from the top of rails of said tracks to the lowest portion of the steel work above said tracks for a width of not less than twenty-five (25) feet. The clear distance between the steel posts supporting the metal span over said location and tracks shall be not less than thirty (30) feet.

Third. — That portion from an abutment forty (40) feet west of the west shore of Fish Island to the present abutment on the east shore of Fish Island shall have masonry retaining walls on the north and south lines; the space within said walls and abutments to be filled with suitable filling. The roadway for the entire structure from the east line of Water Street to the east side of Fish Island shall not exceed fifty-four (54) feet in width, and shall be paved with vitrified paving brick on a concrete base, and curbed with granite on the solid fill sections and with steel on the metal work. There shall be a sidewalk on each side of the roadway not exceeding eight (8) feet in width, with a cement concrete surface commonly known as "granolithic." There shall be an iron railing of suitable design on both sides of the bridge, and approaches set on top of retaining walls and outer fascia girders of metal work.

Fourth. — That portion of the present surface beneath the metal structure within said location from the abutment near the west line of Front Street to the west line of the location of the Old Colony Railroad shall be paved with granite blocks for a width of forty-seven (47) feet, with tar concrete sidewalks and granite curbing. That portion of the surface beneath the metal structure within said location from the east line of the location of the Old Colony Railroad to the New Bedford abutment shall be graded with coarse gravel to the grades described.

Details of construction of said bridge and approaches are shown on nine plans thereof, numbered 1, 2, 3, 4, 5, 6, 7, 8 and 9, and verified by the signatures of the joint Board, dated Jan. 25, 1901, and made a part of this decree.

VI. We prescribe that the highway, bridge and the approaches and ways leading thereto and the ways underneath the same as hereinbefore set forth shall be constructed and completed as to location, grades and manner, in strict compliance with all the requirements herein and as set forth in detail in the plans and specifications aforesaid adopted and approved by this joint Board, and made part hereof; and that all the same, together with this order, forthwith shall be filed in the registry of deeds for the county of Bristol, southern district, by said city of New Bedford, all in accordance with the provisions of chapter 439 of the Acts of 1900.

JAMES F. JACKSON,
GEORGE W. BISHOP,
HERSEY B. GOODWIN,
Board of Railroad Commissioners.
WOODWARD EMERY,
CLINTON WHITE,
CHAS. C. DOTEN,
Board of Harbor and Land Commissioners.

On January 25 the joint Board, after considering four proposals for the foundation, masonry and roadway, and eleven proposals for the metal work for the completion of the bridge and highway between the east line of Water Street and the east side of Fish Island, submitted by the mayor of New Bedford as received by his city in response to advertisements, approved the action of the city in passing the following votes: —

Voted, That the joint Board of Railroad Commissioners and Harbor and Land Commissioners, acting under the provisions of chapter 439 of the Acts of the year 1900, having listened to the report of a committee of the city council of the city of New Bedford, to whom was referred the question of the approval of the contract between the city of New Bedford and the American Bridge Company for furnishing and erecting the metal work for the completion of the New Bedford and Fairhaven bridge for the sum of $94,540, presented to said joint Board on Jan. 25, 1901, by the mayor of the city of New Bedford, do hereby approve the action of said committee in recommending said city to execute the contract aforesaid with the American Bridge Company, and hereby approve the acceptance of said bid by said city.

Voted, That the joint Board of Railroad Commissioners and Harbor and Land Commissioners, acting under the provisions of chapter 439 of the Acts of the year 1900, having listened to the report of a committee of the city council of the city of New Bedford, to whom was referred the question of the approval of the contract between the city of New Bedford and Miller & Ellis, for the sum of $152,865, for the foundation, masonry and roadway construction of the New Bedford and Fairhaven bridge, presented to said joint Board on Jan. 25, 1901, by the mayor of the city of New Bedford, do hereby approve the action of said committee in recommending said city to execute the contract aforesaid with Miller & Ellis, and hereby approve the acceptance of said bid by said city.

On February 7 the joint Board approved the contracts executed in pursuance of the foregoing, then submitted, and also the surety for the performance thereof, as appears by the following votes and endorsements: —

It was unanimously *Voted*, That the joint Board established under the provisions of chapter 439 of the Acts of 1900 hereby approves the contract and specifications for the construction of foundations, retaining walls, piers, abutments, roadway, pavements, sidewalks and other fixtures, required for the construction of the New Bedford and Fairhaven bridge, from the east line of Water Street to the east side of Fish Island, exclusive of the "metal work," dated Feb. 4, 1901, and executed by and between the city of New Bedford and William L. Miller & William H. Ellis, for the sum of $152,865; also bond in the sum of $38,217, annexed to said contract.

It was unanimously *Voted*, That the joint Board established under the provisions of chapter 439 of the Acts of 1900 hereby approves the contract for furnishing and erecting the metal work required in the construction of the New Bedford and Fairhaven bridge from the east line of Water Street to the east side of Fish Island, dated Feb. 4, 1901, and executed by and between the city of New Bedford and the American Bridge Company for the sum of $94,540; also bond in the sum of $23,635, annexed to said contract.

The following endorsement was made on each of the said contracts: —

COMMONWEALTH OF MASSACHUSETTS.

SUFFOLK, SS.

At a meeting of the joint Board of Railroad Commissioners and Harbor and Land Commissioners, held under the provisions of chapter 439 of the Acts of 1900, at Room 130, State House, Boston, on Thursday, Feb. 7, 1901, all the members being present, it was unanimously voted to approve the within contract and bond.

FREDERICK N. WALES,
Clerk of the joint Board.

At a subsequent meeting of the joint Board, the appointment of William F. Williams to be chief engineer of the New Bedford and Fairhaven bridge, at a stated salary, was approved, as was also his charge for services relating to the bridge up to Jan. 1, 1901.

On June 5 the joint Board met, and the following votes were passed: —

Voted, That the letter of William F. Williams, chief engineer of the New Bedford and Fairhaven bridge, dated May 22, 1901, and addressed to Miller & Ellis, the contractors, ordering extra work upon said bridge to the amount of $1,065.35, is hereby approved.

Voted, That the acceptance by the city of New Bedford, on May 21, 1901, of the proposal to said city made through Chambers & Hone of New York, of the Pittsburgh Testing Laboratory, Limited, for the inspection of the mill and shop work on the metal work required in building the New Bedford and Fairhaven bridge, under chapter 439 of the Acts of 1900, at a price of 30 cents per net ton of 2,000 pounds for mill inspection and 35 cents per ton for shop inspection, be and hereby is approved.

On November 1 the joint Board met for the purpose of considering the propriety of extra work in the construction of the abutments and piers of the water section; and, after a full hearing and careful investigation, unanimously

Voted, That the letter of William F. Williams, chief engineer of the New Bedford and Fairhaven bridge, dated Sept. 1, 1901, to Miller & Ellis, the contractors, ordering extra work upon said bridge to the amount of $4,208, and approved by the mayor of the city of New Bedford, is hereby approved.

Cape Cod Canal.

On Dec. 6, 1900, the Board gave a hearing relative to approval of plans of location and construction of a canal from Buzzards Bay to Barnstable Bay, by the Boston, Cape Cod & New York Canal Company, which plans had been filed Sept. 28, 1899.

On Jan. 16, 1901, the joint Board met at the request of counsel for the canal company, who submitted the following forms: (1) advertisement for bids; (2) information for bidders; (3) proposals; (4) contract; (5) specifications for jetties; (6) specifications for excavation; (7) specifications for drawbridges; (8) mortgage, — and asked the Board to approve them.

On January 17 the Board received a petition from the company for approval of plans for building structures at the entrance to the canal in Barnstable Bay, issued an order of notice, and on January 22 heard the parties interested. At the close of the hearing the matter was taken under consideration, and subsequently it was voted to issue a license in accordance with the petition upon the filing of certain plans; which, however, have not as yet been filed.

On January 23 the Board met with the Railroad Commissioners as a joint Board, and again listened to the counsel for the canal company relative to the form of documents theretofore filed; but it was obviously unsuitable for the joint Board to be asked to take action before the plans for the construction of the canal had been adopted.

On February 5 the following letter was sent to the Attorney-General: —

FEB. 5, 1901.

Hon. HOSEA M. KNOWLTON, *Attorney-General of the Commonwealth, State House, Boston*

SIR: — One or two questions have arisen on the construction of chapter 448, Acts of 1899, and the Board would like your advice as to the correct interpretation thereof.

Section 4 requires the Boston, Cape Cod & New York Canal Company to "file with the Harbor and Land Commissioners a plan of the proposed location and a plan of the proposed construction thereof," which has been done within the time required; and then says: "The plan so approved or modified, being accepted by said company, shall be deemed to be the plan of the location and construction of said canal, and said company shall be authorized to construct its canal in accordance therewith." Later, in section 6, the statute says: "Said canal company shall construct its canal with such structures and appliances for its protection and use as said joint Board may order, together with such bridge or bridges, tunnel or tunnels, ferries and changes of highways, under the supervision of said joint Board, as shall be in accordance with plans approved by them and in conformity with such orders as they may make."

The question upon which advice is desired is: Should this Board, under section 4, approve a plan of construction which did not include a lock, or locks, or gates, would it be in the power of the joint Board, under section 6, to order such structures to be built?

Yours respectfully, WOODWARD EMERY,
Chairman.

On February 12 the following opinion was received from the Attorney-General: —

BOSTON, Feb. 11, 1901.

Hon. WOODWARD EMERY, *Chairman, Harbor and Land Commission, Boston, Mass.*

DEAR SIR: — The charter of the Cape Cod Canal, Statutes of 1899, chapter 448, provides, in section 4, that the corporation shall file with your Board "a plan of the proposed location and a plan of the proposed construction thereof." It is the duty of the Board thereupon to hear the parties, require such modification, if any, as it may desire, and to approve the plans as filed or as modified.

Section 6 provides that the joint Board of Harbor and Land Commissioners and the Railroad Commissioners shall "determine at what point or points the railroad of the Old Colony Railroad Company shall cross said canal by a drawbridge or bridges, or by a tunnel or tunnels constructed under said canal." The section further provides that the canal company shall construct its canal "with such structures and appliances for its protection and use as said joint Board may order, together with such bridge or bridges, tunnel or tunnels, ferries and changes of highways, under the supervision of said joint Board, as shall be in accordance with the plans approved by them and in conformity with such orders as they may make."

The precise question submitted by your letter of February 5 is as follows: "Should this Board, under section 4, approve a plan of construction which did not include a lock, or locks, or gates, would it be in the power of the joint Board, under section 6, to order such structures to be built?"

I very much doubt whether your Board has the right to my opinion upon the question submitted. It is rather for the joint Board, if a situation arises before that Board which will make it material. But it may not be amiss for me to submit my views as to the duty of your Board under section 4, above quoted. It imposes, in my opinion, upon your Board the duty of determining in what manner the canal shall be constructed. This includes all questions relating to locks, tide gates and such other structures. You are to have in view the use of the canal for purposes of navigation, and to determine what method of construction will be the safest and most convenient in view of all the facts and probabilities, including the probable rate of tide in the canal, and how far its current may make navigation dangerous if unrestrained by structures intended to prevent such movement.

You have no means of knowing, of course, whether the joint Board will order the crossing in question to be effected by a tunnel or a bridge; but I assume that it is not unreasonable for you to anticipate that bridges, either for the railroad or for highways, will be necessary. In all events, the question of such probability is before you, and it is your duty to order the construction of the canal in such manner as will provide for all these circumstances and probabilities. The determination, therefore, of the question of locks and gates is confided to the discretion of your Board.

The obvious purpose of section 6 is to submit to the joint Board all questions concerning the crossing of the canal by the railroad company. These questions are submitted to the joint Board rather than to your Board, for the reason that they involve on the one hand the considerations affecting railroad transportation, and navigation on the other.

The precise question whether the joint Board will have jurisdiction to order the construction of locks, in case you shall have approved plans which do not call for such structures, is one which does not concern, in my judgment, your duty under section 4, and which may well be determined when, if ever, it arises.

Yours very truly, HOSEA M. KNOWLTON,
Attorney-General.

On February 26 the Board, after various and sundry conferences and consultations with the engineers both of the Board and of the company, and after hearing its counsel with reference to requiring a lock in the canal, passed the following votes in regard to plans and modifications thereon: —

Voted, That the plans filed with the Board of Harbor and Land Commissioners, Sept. 28, 1899, by the Boston, Cape Cod & New York Canal Company, under section 4 of chapter 448, Acts of 1899, are, in the public interest, after public notice and hearing, by virtue of the provisions of said act, hereby required to be modified as follows, to wit: —

MODIFICATIONS REQUIRED BY THE BOARD OF HARBOR AND LAND COMMISSIONERS IN THE PLANS SUBMITTED BY THE BOSTON, CAPE COD & NEW YORK CANAL COMPANY.

Location Plan.

The plan of location should show the exact situation of certain highways and bridges which now exist on the location of the canal, not shown on the plans. The shore lines and some small details at the westerly end of the canal should be altered to conform to the present conditions. The location of the westerly end of the canal shall be changed and delineated on the plan so as to conform to the plan hereto annexed, which is in substantial accordance with the statement of the engineer of the canal, as made at the hearing. In addition to the bearings written along the centre line of the canal, an arrow showing the meridian should be placed on each sheet. All to be to the satisfaction of the Board, so that the location may be sufficiently accurate for identification.

Construction Plans.

1. The plans must show the entire wetted perimeter throughout the length of the canal protected from erosion by stone or some similar indestructible material, except where the material through which the canal is excavated is of such a nature as not to be liable to erosion by the currents which are expected to flow through it.

From about 3 feet below mean low water to about 3 feet above mean high water the protective covering on the banks must be sufficient to prevent erosion from the waves created by passing vessels.

Profile.

2. The profile along the centre line of the proposed canal must, in addition to the elevations of the present surface of the ground and of the bottom of the canal, exhibit, so far as is known, the kind, location and extent of the various classes of material through which the canal is to be built.

All the elevations, so far as is practicable, must be marked on the plan in figures.

The kinds of material indicated must be described on the plan as accurately as may be in a few words.

Structural Plans.

3. One plan must show the centre line of the canal with the various bottom widths and the locations where they occur, including four meeting places for passing vessels, to be located at or near stations 112–190–328 + 50 and 380 on the plans heretofore filed. At these stations the canal to be not less than 300 feet wide on the bottom, this width to be gradually reduced on both sides of said stations, until at a distance of from 1,600 to 1,800 feet it reaches the standard bottom width of the canal at that point. It must also show the location of the various cross-sections described below.

Other plans must show enough cross-sections in detail at various points throughout the canal wherever material variations occur either in dimensions or method of construction, with verbal description where necessary.

The dimensions of the various parts must be placed on the plan in figures.

In General.

All information necessary to ascertain how and where the canal is to be constructed, without the aid of other specifications, must be placed upon the plans. The plans should be in sheets of a standard size, so that they may be bound in two atlases. The detail upon the various plans must be sufficient to satisfy the Board.

A title page should be added to each atlas, stating what the plans are, by whom filed, scale, date and all necessary explanatory notes, to be identified by the signature of the engineers or some officer of the canal company.

The question of locks is one relating to structures and appliances for the protection and use of the canal, and consequently must be passed upon by the joint Board, under section 6, chapter 448, Acts of 1899.

A copy of the foregoing was forwarded to the Boston, Cape Cod & New York Canal Company, to which the following reply was received: —

Boston, Feb. 27, 1901.

The Board of Harbor and Land Commissioners, State House, Boston, Mass.

Gentlemen: — We beg to acknowledge the receipt of a copy of the votes of the Board, passed on the 26th inst., and forwarded us by the clerk of the Board, pursuant to your resolution, and in part entitled, "Modifications required by the Board of Harbor and Land Commissioners in the plans submitted by the Boston, Cape Cod & New York Canal Company."

We have submitted the same to the engineer of the company for examination, requiring a reply from him to certain questions which are fully set forth in his letter, a copy of which we have the honor to enclose herewith.

In view thereof, we believe that the modifications required are acceptable to the canal company, and the same will be prepared as rapidly as possible.

Respectfully,
Boston, Cape Cod & New York Canal Company,
By Walter Clifford,
Clerk.

Feb. 28, 1901.

Boston, Cape Cod & New York Canal Company, 301 Tremont Building, Boston, Mass.

Gentlemen: — Replying to the questions referred to me by you, — "First, are the modifications required by the Board of Harbor and Land Commissioners to be made by the canal company in its plans, modifications which will increase the efficiency and availability of the canal, with reasonable regard to economy in construction? Second, how long will it take to prepare modified plans in accordance with the requirements of the Board?" — I submit the following: —

Referring to the communication from the Board, dated the twenty-sixth day of February, 1901, I am of the opinion that the modifications required are to the best interests of the canal, for they will tend to maintain its permanency and facilitate its operation.

Apart from mere questions of detail in the modified plans, the substantial recommendations are: (*a*) The change of the line at the Buzzard's Bay end of the canal, which I have already recommended to the company. (*b*) The widening of the canal at the points where it is crossed by the bridges, which I have equally commended. It seems to me that this last modification is a wise one, as by such widening the velocity of the current at those points will be about halved, with a tendency to reduce by irregularity of sections the velocity throughout the canal. (*c*) The modifications requiring that the plans show the entire wetted perimeter throughout the length of the canal protected from erosion, by stone or other similar indestructible material, *except* where the material through which the canal is excavated is of such nature, in part or in whole, as not to be liable to erosion by the currents which are expected to flow through it. This requirement is entirely proper in principle, although there might be some question as to where and to what extent this protection is necessary. From my interview with Mr. Hodgdon, the engineer of the Board, I infer that the Board intends this to be treated from a practical standpoint, and does not intend that we shall provide for work which would be of doubtful utility, and can be done later if found necessary. Lastly, (*d*) as to wave protection, — the only additional modification that I would suggest is that where needed it be carried 5 feet below and above mean low and high water, instead of 3 feet, as required by the Board.

Referring to your second question, it may take some time to prepare the modified plans, as required by the commissioners. I find, however, that we have on hand sufficient blue-prints of plans made from time to time to enable us, with some slight additions and changes, to furnish the Board with provisional modified plans, sufficient for all present purposes.

Respectfully submitted, A. L. RIVES,
Chief Engineer.

On March 14 the joint Board met, and it was decided to ask the opinion of the Attorney-General upon certain legal questions submitted in the following letter: —

MARCH 14, 1901.

Hon. HOSEA M. KNOWLTON, *Attorney-General, Boston, Mass.*

DEAR SIR: — The joint Board of Railroad and Harbor and Land Commissioners met to-day to take up their duties under the recent statutes relating to the construction of a canal between Buzzard's Bay and Barnstable Bay.

At the outset we find a legal problem which we desire to submit to you.

The Board of Harbor and Land Commissioners *having approved plans* for the construction of this canal without having determined the necessity of locks, does the joint Board have jurisdiction over that question, under the provisions of section 6, chapter 448, Acts of 1899, upon the theory that it should consider locks as a structure or appliance required for the protection and use of the canal?

It has occurred to us that even although, as you have decided, the Board of Harbor and Land Commissioners had the right to pass upon the question of locks, nevertheless, that Board not having passed upon it, and having approved plans without reference to locks, the joint Board ought to take up that matter, upon the theory that the lock is a structure or appliance necessary for the protection and use of the canal.

Before proceeding, we would like to know what your views are upon this point, in view of the fact that an opinion has already been rendered which might seem to preclude the joint Board from passing upon this question.

Yours very truly, JAS. F. JACKSON,
Chairman, Joint Board.

On April 11 the joint Board met in conference for the purpose of reading the reply of the Attorney-General, which is as follows: —

BOSTON, April 6, 1901.

Hon. JAMES F. JACKSON, *Chairman, Board of Railroad Commissioners, Beacon Street, Boston, Mass.*

DEAR SIR: — Your letter of March 14 states that the plans of the Boston, Cape Cod & New York Canal Company have been approved by the Board of Harbor and Land Commissioners, in accordance with the provisions of the charter of the company (Statutes of 1899, chapter 448, section 4), and are now before the joint Board of Harbor and Land Commissioners and the Railroad Commissioners, for action by the Board under the provisions of section 6 of the same statute. Your letter further states that the Board of Harbor and Land Commissioners approved the plans "without having determined the necessity of locks," and requires the opinion of the Attorney-General upon the question whether, in view of that fact, the joint Board has jurisdiction of the question of locks.

The jurisdiction of the joint Board is, in my judgment, in no way dependent upon the action of the Board of Harbor and Land Commissioners. The charter in separate sections (4 and 6) clearly points out the duties devolving upon each Board, and the authority and responsibility of each Board is to be found in those provisions. Yours is not a board of appellate but rather of original jurisdiction.

In a letter to the Board of Harbor and Land Commissioners, dated Feb. 11, 1901, I pointed out what appeared to me to be the duties of that Board in these words: "You are to have in view the use of the canal for purposes of navigation, and to determine what method of construction will be the safest and most convenient in view of all the facts and probabilities, including the probable rate of tide in the canal, and how far its current may make navigation dangerous if unrestrained by structures intended to prevent such movement."

To these views, after the re-examination made necessary by the request of your Board for an opinion, I still adhere. The scheme of the statute, although not always expressed in the clearest terms, appears to me to be as follows: the company chartered must, within four months, file with the Harbor and Land Commissioners a plan of the proposed location and "a plan of the proposed construction thereof." I see no reason to doubt that the word "construction" necessarily includes and was intended by the Legislature to include all things appertaining to the construction of the canal, including the question of locks, which, I take it, is one of the most important questions touching the construction of a canal.

Before filing such plans, the company must deposit with the Treasurer of the Commonwealth the sum of $200,000, to be held as security for the payment of damages occasioned by the taking of land. If the plans are not approved by the Board of Harbor and Land Commissioners, or if the modifications ordered by them are not acceptable to the company, it may withdraw its deposit and forfeit its rights under the charter (section 23). But if, on the other hand, it is content with the plans of location and construction as finally approved by the Harbor and Land Commissioners, the deposit cannot be withdrawn, and, whatever future action the company may take, its deposit must remain in the treasury.

It is apparent, therefore, that the question of the approval of the plans by the Harbor and Land Commissioners is one of vital importance to the company. If, for example, the plans as finally adopted by that Board require a method of construction which, in the opinion of the company, is too expensive to be profitable, the opportunity is given it to abandon its project and receive its money back. It has a right, therefore, to know, before going further, just what is required of it in the way of location and construction.

Furthermore, the jurisdiction of the question of location and construction is confided to a Board which is presumed to be especially familiar with that subject, and which can adequately represent the interests of the Commonwealth and of the public. It is the duty, therefore, of the Harbor and Land Commissioners to settle all questions of construction, with one exception; that exception is the matter of the crossing of the canal by the railroad company. The jurisdiction of this question is given to a joint Board, consisting of the Railroad Commissioners on the one hand and the Harbor and Land Commissioners on the other; it being presumed that conflicting questions between the railroad and the canal are properly submitted to such a tribunal. Section 6, therefore, provides that such joint Board shall "determine at what point or points the railroad of the Old Colony Railroad Company shall cross said canal by a drawbridge or bridges, or by a tunnel or tunnels constructed under said canal." Such joint Board, after due notice, "shall determine said questions, and the decision of a majority of said joint Board shall be final. Said canal company shall construct its canal with such structures and appliances for its protection and use as said joint Board may order, together with such bridge or bridges, tunnel or tunnels, ferries and changes of highways, under the supervision of said joint Board, as shall be in accordance with plans approved by them."

All questions, therefore, which may arise concerning the manner of the crossing of the canal by the railroad company, and they only, are within the jurisdiction of the joint Board.

The determination of these questions may incidentally involve the further question whether, for the protection of the canal on the one hand or the railroad on the other, locks may be required; and it is in that aspect only that your Board has to determine any question concerning locks. Questions of navigation, or the velocity of the tide, and all other matters incidental to the question of the necessity of locks, are presumed to have been determined by the Board of Harbor and Land Commissioners before the plans come to your Board.

I do not forget that the words above quoted, "said canal company shall construct its canal with such structures and appliances for its protection and use as said joint Board may order," taken alone, might seem to give original jurisdiction to your Board of the question of locks. But I cannot believe the Legislature intended a divided responsibility. As I have already said, each Board has its own duties in the matter. Your Board is concerned only with the crossing of the railroad; and the words "structures and appliances" must be taken, in connection with the rest of the section, to refer only to the matters to which the section as a whole relates. This is still more apparent from the fact that, after action by the Board of Harbor and Land Commissioners, the company, having elected to proceed, is not at liberty to withdraw and to receive back its deposit. It is not to be presumed that the Legislature, having once given an opportunity to the company to take back its deposit and withdraw from the enterprise, if the conditions as to construction imposed by the Board having jurisdiction of the matter are too onerous, should authorize another board to reimpose the same conditions, when the time for withdrawal has elapsed.

I am of the opinion, therefore, that the question of locks is not before your Board, excepting so far as the necessity of them may arise in consequence of the method of crossing by the railroad company determined upon by the Board may require structures for the protection of the canal and of the railroad company.

Very respectfully, HOSEA M. KNOWLTON,
Attorney-General.

On April 15 the following letter was sent to the counsel for the canal company: —

BOSTON, April 12, 1901.

HON. WILLIAM M. BUTLER, *Counsel, Boston, Cape Cod & New York Canal Company.*

DEAR SIR: — The members of the joint Board of Railroad and Harbor and Land Commissioners met yesterday, to consider the opinion of the Attorney-General, defining the duties of the Board.

Following out this interpretation of the law, it seems clear that the joint Board has no jurisdiction until after an approval of plans for the construction of the canal by the Board of Harbor and Land Commissioners, and until application has been made by the canal company, under section 6, chapter 448, Acts of 1899. As soon as such application is made, the joint Board will, after due notice to the parties, proceed to determine the question of structures and appliances in accordance with the provisions of the above-named section. If the plans approved by the Board of Harbor and Land Commissioners shall provide for a canal without locks, the joint Board may be called upon to consider the subject of locks as structures or appliances, within the meaning of this section of the statute.

We understand that the canal company has not as yet adopted on its plans the modifications suggested by the Board of Harbor and Land Commissioners, and that said plans have not been laid before that Board for final approval.

Very truly yours, JAMES F. JACKSON,
Chairman.

On May 9 a petition of the company was filed with the joint Board for authority to issue capital stock to the amount of $360,000, and bonds to a like amount, under authority of chapter 476 of the Acts of 1900. The following is a copy of the petition: —

COMMONWEALTH OF MASSACHUSETTS.

To the Board of Railroad Commissioners and Harbor and Land Commissioners, sitting as a Joint Board.

RESPECTFULLY REPRESENTS the Boston, Cape Cod & New York Canal Company, a corporation organized under chapter 448 of the Acts of 1899 and chapter 476 of the Acts of 1900, as follows: —

First. — This Board, sitting as a joint Board, by order dated June 26, 1899, authorized the issue of stock of your petitioner to the amount of one hundred forty thousand dollars ($140,000), and bonds to a like amount, as soon as a deposit of two hundred thousand dollars ($200,000) should be made by your petitioner with the Treasurer of the Commonwealth, in accordance with the provisions of section 23 of chapter 448 of the Acts of 1899; and the issue in like manner of such further amounts of stock and bonds, not to exceed in the aggregate (including the issues above mentioned) six million dollars ($6,000,000) each, as from time to time on the application of your petitioner should have been approved and certified by said joint Board in the manner provided in chapter 462 of the Acts of 1894, as reasonably requisite to enable your petitioner promptly and in good faith to carry out the purposes set forth and specified in said chapter 448 of 1899; *provided*, that the total amount of bonds so approved, certified and issued should at no time exceed the total amount of capital stock then actually paid in and outstanding as aforesaid.

Second. — Prior to said order, and on the tenth day of June, 1899, your petitioner entered into a contract with the Cape Construction Company, a corporation duly organized under the laws of the State of New Jersey, by the terms whereof said Cape Construction Company agreed, among other things, to deposit for and on account of your petitioner the sum of two hundred thousand dollars ($200,000) with the Treasurer of the Commonwealth of Massachusetts, the sum of twenty-five thousand dollars ($25,000) with the treasurer of the county of Barnstable, and the sum of five hundred dollars ($500) each to the towns of Bourne and Sandwich, within the times required by, and in accordance with, the provisions of said chapter 448 of the Acts of 1899 for the making of such payments and deposits; and to proceed with all convenient speed to survey and lay out the location of the canal described in the charter of your petitioner, and file within four (4) months from the first day of June with the Harbor and Land Commissioners a plan of the proposed location and a plan of the proposed construction of said canal; and your petitioner agreed that on the deposit and payment of the several sums required by its charter to be paid and deposited in accordance with the provisions of said charter with the Treasurer of the Commonwealth, the treasurer of the county of Barnstable and to the towns of Sandwich and Bourne, being in all the sum of two hundred twenty-six thousand dollars ($226,000), and upon the filing with the Board of Harbor and Land Commissioners of plans of the proposed location and construction of said canal, with the breakwaters, docks, wharves and other structures necessary for the convenient use of said canal in a form satisfactory to your petitioner, your petitioner would, as soon as might be thereafter, and upon request of said Cape Construction Company, forthwith pay and deliver or cause to be paid and delivered to said construction company shares of the capital stock and bonds of your petitioner of the par value of five hundred thousand dollars ($500,000) of each such stock and bonds to be issued pursuant to its charter.

Third. — Under the aforesaid order there have been certified and issued to your petitioner stock to the amount of one hundred forty thousand dollars ($140,000), and bonds to a like amount.

Fourth. — Said Cape Construction Company has made all deposits and payments and performed all acts necessary under its contract with your petitioner above mentioned to entitle it to the payment and delivery to it by your petitioner of shares of the capital stock and bonds of your petitioner to the par value of five hundred thousand dollars ($500,000) of each such stock and bonds to be issued pursuant to its charter, except the deposit of twenty-five thousand dollars ($25,000) with the treasurer of Barnstable County, and that it stands ready to deposit said amount; and upon such deposit your petitioner will be liable to said Cape Construction Company for the payment and delivery of said stock and bonds, but is unable to meet said obligation until the certificate and issue to it of stock to the amount of three hundred sixty thousand dollars ($360,000), and bonds to a like amount, shall be approved and certified by this Board, sitting as a joint Board; and that, in order to enable your petitioner to comply with the other terms of said contract to be subsequently performed, it will be necessary that the further amounts of said stock and bonds mentioned in said contract be issued and certified as provided by said contract.

WHEREFORE, your petitioner prays that this joint Board will approve and certify to the Old Colony Trust Company as reasonably requisite to enable your petitioner to promptly and in good faith carry out the purposes set forth and specified in said chapter 448 of the Acts of 1899, the immediate issue and certification of capital stock of your petitioner to the amount of three hundred sixty thousand dollars ($360,000), and of bonds to a like amount and the further issue and certification of stock and bonds to the amounts set forth in said contract, from time to time, on certificate of this Board that the work required under said contract for the delivery of such stock and bonds has been completed.

BOSTON, CAPE COD & NEW YORK CANAL COMPANY,
By CHARLES C. DODGE,
President.

On May 23 the joint Board met, and heard parties interested on the foregoing petition, and took the matter under advisement.

On July 1 the joint Board met, and signed the following order, refusing to approve an issue of stock and bonds by the canal company, as petitioned for May 9, 1901: —

PETITION OF THE BOSTON, CAPE COD & NEW YORK CANAL COMPANY FOR APPROVAL OF AN ISSUE OF STOCK AND BONDS.

After due notice to all parties interested, a public hearing was given upon this petition.

The petitioner in the early part of 1899 applied to this Board, under the provisions of chapter 448 of the Acts of 1899, for authority to issue capital stock to the amount of $6,000,000, and bonds to the amount of $6,000,000.

After a careful consideration of the evidence and arguments presented in support of the petition, the Board issued an order, under date of June 26, 1899, authorizing the issue of this amount of stock and bonds, in such amounts as the Board from time to time, upon evidence presented to it, should deem requisite for carrying out the lawful purposes of the company.

The order authorized an immediate issue of stock to the amount of $140,000, and of bonds to a like amount, to provide the means for payment of certain deposits which the statute required the company to make, and for payment of expenses connected with the making of surveys and plans. The approval of the issue was made dependent upon the performance of certain conditions named in the order.

Upon the request of the petitioner for a modification of this order, the case was re-argued in the following September, and modification refused.

Since then additional legislation has been secured by the petitioner, to be found in chapter 476 of the Acts of 1900. That statute authorizes the joint Board to approve a contract or contracts for the building of the canal, by the terms of which stock and bonds may be issued in payment for labor and material; but provides that such contract or contracts shall first be open to bids, and that there shall be public advertisement for such bids. It is suggested by counsel for the petitioner that the Board has power to waive the giving of the public notice named in this statute. We cannot agree that we have this power, nor that, if we had it, we ought to exercise it. The opportunity through advertisement for bids to secure the benefits of competition are clearly an essential feature of the legislation of 1900.

The petition now before us is based, then, upon the same provisions of law that governed the action of the Board upon the former petition. Indeed, the petitioner practically admits this, but claims that conditions have materially changed. It is true that some additional steps have been taken, looking to the carrying out of the enterprise. Large expenditures have been made upon plans for the construction of the canal, and in the presentation of them to the Board of Harbor and Land Commissioners. That Board, after several hearings and a careful, expert investigation, has suggested certain modifications in the plans, and has signified that upon the adoption of such modifications the plans will be approved. There still remain, however, questions of great importance connected with the construction of works necessary to the completion of the canal. No steps have as yet been taken to bring these questions before the joint Board which is to decide them. Moreover, although full authority was given to the petitioner, under the order of 1899, to issue stock and bonds for certain specific purposes, no such issue has been made, and the requirements of the order in respect to the preliminary steps to be taken by the company have not been carried out.

At this point we are asked to approve an issue of stock and bonds upon the basis of a contract between the Boston, Cape Cod & New York Canal Company, the petitioner, and what is known as the Cape Construction Company, executed June 10, 1899, which provides for the payment to the Construction Company of $12,000,000 in stocks and bonds as the cost of building the canal. An approval of this petition, although it calls for the issue at present of stocks and bonds amounting to $1,000,000 only, would be to all intents and purposes an approval of that contract; would mean that, without any presentation of evidence of the actual or estimated cost of the completed canal, the joint Board would be irrevocably committed to the possible over-capitalization of a public enterprise. All the arguments in favor of such action were exhaustively presented to this Board in connection with the petition of 1899. The circumstances under which these arguments are again urged upon our attention are substantially unchanged, and the joint Board sees no reason to depart from its former adjudication.

Whenever the company shall offer satisfactory evidence to prove that an issue of capital stock and bonds is reasonably requisite to carry out any one of the purposes recognized by the statute, the approval of this Board will be given to such issue upon conditions similar to those named in its former order.

We cannot, upon the evidence presented in support of this petition, approve the proposed issue of stock and bonds.

JAMES F. JACKSON,
GEORGE W. BISHOP,
CLINTON WHITE,
Railroad Commissioners.
WOODWARD EMERY,
CHAS. C. DOTEN,
GEO. E. SMITH,
Harbor and Land Commissioners.

BOSTON, July 1, 1901.

APPONAGANSETT HARBOR.

By chapter 38 of the Resolves of 1901, the Board was directed to cause a survey and estimate to be made as to the advisability and cost of improving the harbor at Apponagansett in the town of Dartmouth, by constructing a breakwater at its entrance or by some other means, and to report thereon to the General Court.

The necessary survey and estimate has been made, and the report of its engineer duly considered by the Board.

The construction of a stone breakwater at the entrance to Apponagansett harbor is entirely feasible, and is unquestionably the best means of affording the desired protection. The large cost of the project would raise a question as to its advisability. A plan of the project is appended. The report of the engineer in full is as follows: —

BOSTON, Dec. 18, 1901.

To the Board of Harbor and Land Commissioners, State House, Boston.

GENTLEMEN: — In accordance with your instructions, I have had a survey and estimate made to determine the cost of improving the harbor at Apponagansett in the town of Dartmouth by constructing a breakwater at its entrance and removing some of the bowlders which obstruct the anchorage ground, pursuant to the provisions of chapter 38 of the Resolves of 1901.

The harbor is formed by a bay at the mouth of Apponagansett River in South Dartmouth, on the western shore of Buzzards Bay, about 2 miles south of New Bedford. The bay is about 3,000 feet wide at its mouth opposite Ricketson's Point, and narrows to about 1,500 feet at the bridge, 4,000 feet above, which is practically the limit of navigation. The anchorage in the bay is well protected from winds coming from all directions except the south-east, and gales from this direction often come up suddenly and are quite violent, having a rake of the whole width of Buzzards Bay for about 11 miles.

The survey covers the whole area of the bay, the topography being carried for about 1,000 feet northerly along the Buzzards Bay shore and down to the Nonquit wharf on the southerly shore of the bay. The soundings cover the whole area from the bridge down to the mouth of the bay, and extend out into the sound a sufficient distance to cover all possible locations of a proposed breakwater. The bottom of the bay is quite hard, as shown by the many rocks projecting above its surface. Ricketson's Point consists of ledge, the outer slopes of which are covered with many bowlders.

At the anchorage inside Ricketson's Point and within the line of the proposed breakwater there is a depth of not less than 12 feet of water over an area of 101 acres, and a very large part of this is over 16 feet in depth; and, if it is protected from southeasterly gales, it will afford a remarkably convenient and safe anchorage. At the present time it is much frequented by yachts from New Bedford, yacht owners preferring to keep their yachts here rather than in New Bedford harbor, where the water has become so foul as to interfere very much with keeping the yachts clean. During the last year the New Bedford Yacht Club has erected a club house near the bridge at the head of this harbor; and, as there is an electric car line which makes frequent trips between South Dartmouth and New Bedford, it is very convenient for yachtsmen, as a yacht can get into the open bay much quicker from this point than from New Bedford harbor in the south-westerly winds which prevail in summer.

The only question seems to be as to the best location for the breakwater; and, having due regard for the cost of the work and the anchorage area to be secured, I have finally located it running in a south-westerly direction from the extreme end of Ricketson's Point, leaving the opening between the south-westerly end of the breakwater and the 12-foot curve on the Nonquit shore about 800 feet. This will protect, as before stated, an area of 101 acres, having a depth of more than 12 feet at mean low water; and, if a larger area is required in the future, it would probably be cheaper to dredge the flats at that time than to locate the breakwater farther out to sea at the present time.

During the survey our attention was called to a number of bowlders scattered in various parts of the harbor, and an effort was made to find and determine their location. A number of these bowlders were found and their position marked on the chart; but the engineers were told that there were a number of others, but they were unable to find any one who had time to go out and point out their location, and, although search was made, they were unable to find them themselves.

The cheapest effective form of breakwater which can be built in this location is one composed of granite quarry grout, having side slopes flat enough to stand the effects of the sea, the blocks on the exposed faces being large enough not to be individually rolled about by the sea to which they are exposed. I have planned this breakwater to be 10 feet wide on top, at an elevation 10 feet above mean low water; the outer face to slope at an angle of 1½ to 1 from the top to the bottom; the back side toward the harbor to be vertical for a distance 5 feet from the top, and then slope at an angle of 1½ to 1 to the bottom; the head at the outer end of the breakwater to be 20 feet in diameter, 10 feet above low water, with side slopes of 2 to 1 all around. This will require about 121,200 tons of stone. The estimated cost of the work is as follows: —

121,200 tons of stone, at $1.20,	$145,440
Removing bowlders from the harbor,	500
Engineering and contingencies,	14,500
Total,	$160,440

The above estimates are for a breakwater to cover the largest possible area of anchorage ground; but if a breakwater should be built only one-half as long, the safe anchorage for small boats and yachts would be very largely increased over what it is at the present time; and if it is desired at any time to complete the work, in order to secure the greatest possible advantage from the breakwater, there will be no loss from taking down the work already constructed, — it will simply have to be added to.

Respectfully, FRANK W. HODGDON,
Engineer.

HERRING RIVER.

By chapter 66 of the Resolves of 1901, the Board was directed to cause a survey and estimate to be made as to the advisability and cost of improving the entrance to Herring River in the town of Harwich, and of erecting barriers for the protection of the beach in that vicinity, in order to provide a harbor of refuge for small sailing craft and to protect the shore line, and to report thereon to the next General Court.

The necessary survey and estimates have been made, and the report of its engineer duly considered by the Board.

In order to maintain an effectual opening at the mouth of the river, it would be necessary to build two jetties, of which the western should be the longer. These may be of timber or of stone, but inasmuch as, if built of timber, they would within a few years require to be reinforced by stone, that is the material the Board would recommend to be used in construction. The jetties for the purpose of navigation alone might be built at substantially right angles to the shore; but the drift of seaweed on this shore cannot be ignored, especially in designing a structure intended for increased comfort and accommodation to the public; therefore the plan providing for a channel at an angle of about 45° to the shore, which is the more favorable to allowing seaweed to drift across the mouth of the opening, is to be preferred, should the Legislature see fit to make the necessary appropriation. The estimate of cost seems large in comparison with the number of possible beneficiaries of the improvement. If built at the angle proposed, there is no certainty that seaweed will not accumulate and create a nuisance, as at Witchmere. For these two reasons the Board is unable to say affirmatively that it is advisable to make the improvement suggested.

A plan of the project is appended. The report of the engineer in full is as follows: —

BOSTON, Dec. 10, 1901.

To the Board of Harbor and Land Commissioners, State House, Boston.

GENTLEMEN: — In accordance with your instructions, I have made surveys and estimates to determine the advisability and cost of improving the entrance to Herring River in the town of Harwich, as authorized by chapter 66 of the Resolves of 1901. The surveys were made in the month of June, and extended for about a mile along the shore of Nantucket Sound at the mouth of the river and for about one mile up the river. The topography was mapped and soundings taken out to a depth of about 10 feet at mean low water. The river is generally about 100 feet wide between the marshes, but widening in places to 200 feet or over. The thread of the channel has a depth, where it passes through the crest of the beach, of from 3 to 4 feet at mean low water, but above this and on the outer slope of the beach it is not over 1 to 1½ feet.

The action of the sea and the current has deposited large quantities of sand in the sound opposite the mouth of the river, so that the line 3 feet below mean low water opposite the mouth is about 1,500 feet from the shore line, while half a mile on either side it is not over one-half that distance.

At the present time there is a timber fence or jetty, built of stakes and planks, on the westerly side of the outlet, which has been built by the town, with the aid of contributions from people living in the vicinity. This structure was built of such light materials that the sea has damaged it so that it has required constant repairs; and, while it has protected the entrance to a certain extent, it has not been sufficient to maintain a safe entrance into the mouth of the river.

There are two bridges crossing the river near its mouth, one about a quarter of a mile from the mouth, which is about 45 feet long and built on piles, the approach on either side being a solid causeway. The opening is so narrow that the current has scoured a deep hole near the bridge. The second bridge is located about one mile from the mouth, and is an iron truss bridge with a span of about 120 feet, the full width of the river between the marshes. Just above this bridge, previous to 1870, a dam was built to reclaim the salt meadows above and turn them into hay land, the same as was done at Green Harbor. This dam remained for a number of years, but some time before 1880 it broke away and was wholly removed. During the time it was in existence the tidal volume of the river was very largely reduced, and, as at Green Harbor, considerable quantities of sand were driven by the sea and the tide into the lower reaches of the river.

The river drains a large territory, extending well up into Brewster, and is the outlet of a number of large ponds in that vicinity; but the fresh water flow is small compared with the tidal flow.

The general drift of the sand along the shore in this vicinity is from west to east, and the jetty already built on the westerly side of the outlet has checked this drift and built out the shore line for about 200 feet beyond the general line of the shore. This protects the beach on the easterly side of the outlet from waves coming from the south-west, but leaves it exposed to those from the south-east, which now cut away the bluffs to the east of the outlet, there being no jetty at present on the easterly side to protect the entrance. This drifting sand, being forced over into the channel faster than it could be cut away by the current, has gradually forced the channel well over to the eastward, so that it now has cut away the sand from back of the jetty, and is flowing out across the line of the inner end of the jetty. The sand thus scoured out is deposited in the sound in front of the outlet.

New works to improve the entrance should consist of a jetty on each side of the mouth of the river, one of which, at least, should extend out to a depth of 3 feet or more at mean low water. If the question were simply to make a safe entrance for boats into the mouth of the river, protected from sand drifted by the waves and current, jetties built out at right angles with the general trend of the shore would probably work best; but in this locality large quantities of seaweed are annually torn up from the bottom of the sound and thrown up on the beach during the summer months. The prevailing summer winds being from the south-west, this is driven along the beach, and would be lodged against the westerly jetty, and become a great nuisance to users of the beach for bathing and similar purposes. This seaweed can be removed only by being taken from the water and carted away, as, if it is allowed to remain, the odors coming from it are very offensive. In order to avoid this trouble, I have designed jetties extending south-easterly, making an angle of about 45° with the general trend of the shore, with the expectation that, as the seaweed is driven by the waves along the shore, it will slide along the back side of the jetty and be carried across the line of the channel and landed on the beach to the eastward, the jetties being planned so that south-westerly waves will strike not exactly at a right angle, but at such an angle as will drive the seaweed along the jetty until it reaches its outer end. One objection to this location of the jetties is that there is some possibility that the sand may be driven by the outer end of the jetty, as it is driven along the shore by the same forces which move the seaweed; but, as the sand is moved by rolling along the beach, and does not float on the surface, as does the seaweed, I do not think that any serious trouble will occur from this cause.

If the jetties are thus located, it will be necessary to deflect the ebb current in the river practically at right angles to the course at which it approaches the beach, and the bank at this place will have to be thoroughly protected to keep it from wearing away.

The easterly jetty is planned much shorter than the westerly one, in order that the seaweed will not be caught in the flood current before it has had an opportunity to pass by the entrance. As the location of the jetties is principally on the flats, whose surface is less than 1 foot below mean low water, estimates have been made for timber jetties as well as for more permanent stone ones; the timber work to be substantially the same as that built at Osterville and Witchmere harbor, and, as at Osterville, they will have to be strengthened with stone at some future time. The width between the jetties has been fixed at 150 feet.

Owing to the limited volume of tidal water, it will be necessary to dredge the entrance channel, as the current will not be strong enough to scour it unaided, relying on the current to maintain it after it is excavated. After a study of the present channels, I have decided to recommend that the dimensions of the proposed entrance channel be as follows: 100 feet wide on the bottom, with the necessary side slopes, and 3 feet deep at mean low water. This gives a section considerably larger than that of the channel which the current now maintains through the beach; but this has to maintain itself by scouring out the sand which is constantly being driven in by the waves, while the new channel will be protected by jetties. In order to get the full benefit of the tidal flow to maintain the channel, the opening in the lower bridge across the river should be made at least double its present width.

On the westerly bank of the river at its mouth is located a large summer hotel and a considerable village of summer cottages, and on the opposite bank there are also a number of summer cottages.

I submit herewith estimates for two methods of improving the entrance: one by a channel to be located substantially at right angles with the shore of the sound, the other with the entrance channel trending to the south-east, planned to avoid the nuisance caused by the drifting seaweed. In each I have estimated the cost of the jetties built both of wood and of stone.

The cost of the first plan may be reduced by omitting 200 feet from the outer end of the easterly jetty; and I would suggest, if this plan is adopted, that this section be omitted, as I have seen channels maintain themselves in very good condition where they were protected by jetties one of which projected a considerable distance beyond the other. If at any time in the future it is found advisable to improve the channel still further, this jetty can be extended to its full length without interfering with any portion of the work previously constructed. The estimates are as follows: —

Channel at right angles to the shore, with timber jetties: —

Dredging,	$9,600
Jetties,	22,500
Supervision and contingencies,	3,200
	$35,300

Channel at right angles to shore, with stone jetties: —

Dredging,	$9,600
Jetties,	44,200
Supervision and contingencies,	5,300
	$59,100

As before stated, this estimate may be reduced by shortening the eastern jetty 200 feet, as follows: —

For the wooden jetties,	$2,700
For the stone jetties,	8,100

Channel at an angle of about 45° to the shore, with timber jetties: —

Dredging,	$7,600
Jetties,	22,600
Supervision and contingencies,	3,000
	$33,200

Channel at an angle of about 45° to the shore, with stone jetties: —

Dredging,	$7,600
Jetties,	41,600
Supervision and contingencies,	4,900
	$54,100

The general location of the proposed jetties is shown on the annexed plan.

Respectfully, FRANK W. HODGDON,
Engineer.

EAST BAY.

Chapter 102 of the Resolves of 1901 reads: "That the board of harbor and land commissioners may, if in their opinion the change of conditions since the surveys and estimates authorized by chapter ninety-six of the resolves of the year eighteen hundred and ninety-nine so warrant, make such further surveys and estimates as they may deem necessary as to the advisability and cost of cutting a channel from East bay, in the town of Barnstable, to Vineyard sound, for the purpose of providing a harbor of refuge; and they shall report thereon to the next general court not later than the first day of February." Upon due consideration, the Board was not of opinion that there was any change of condition sufficient to warrant making further surveys and estimates as to the advisability and cost of cutting the proposed channel.

The estimate of the cost of the channels and protective works, as stated in the annual report of the Board for the year 1899, pages 40–43, cannot be substantially changed without diminishing the extent and character of the protective works provided in that estimate; and the Board has not been able to find any such change in conditions or in the reasons which controlled their previous opinion as to feel justified in recommending any change in the need or extent of the protective works and dredging therein suggested as necessary to properly construct and maintain the desired channel.

BASS RIVER.

By chapter 39 of the Resolves of 1901, the Board was directed to cause a survey and estimate to be made as to the advisability and cost of improving the entrance to Bass River in the towns of Dennis and Yarmouth, and to report on the same as soon as the survey and estimate were completed. This was done, and the report (House, No. 1430) made June 4, 1901, making an estimate of $22,000 as the cost of the suggested improvements. By chapter 113 of the Resolves of the same year the Board was directed to improve the channel in accordance with the report, and an appropriation of $22,000 was made for the purpose.

Plans and specifications were prepared for the construction of two timber jetties, one on either side of the river mouth, and for the excavation of a channel between them, across the flats, to the depth of 4 feet at mean low water.

On November 14, after opening proposals as advertised, a contract for labor and material was made with Augustus Bellevue & Co., the lowest bidder. Work will commence early in the spring.

SCITUATE.

In pursuance of chapter 434 of the Acts of 1900, the Board made an examination of the shores and harbor of the town of Scituate, and concluded that it would be necessary to build a sea wall at the Sand Hills, so called, where the ocean broke across into the harbor in the great storm of November, 1898. Accordingly a contract was made with Taylor, Carr & Andrews, and in accordance therewith a concrete sea wall 998 feet long, with a uniform surface level and about 8 feet above the plane of mean high water, was built at a cost of $5,408.05. The sand comes up to the level of the top of the wall on the inside.

The work was completed in the middle of December, 1900, and has withstood the heavy storms and high tides in the most satisfactory manner. It promises to afford complete protection to the harbor against any easterly or northeasterly gales.

At the request of the selectmen, the Board visited Stage House beach and the beach at the north end between Damon's Island and the Glades. The sea is undoubtedly wearing away the Third Cliff; but the protective work that would prevent the shores of the cliffs from washing would be attended with large expense, and not worthy the undertaking unless the coast for a long distance should be included. At the north end of the beach, however, after a careful examination and watching the effect of some recent storms, notably the one of Nov. 25, 1901, the Board has concluded it would be wise to expend the balance of the appropriation in building a protective wall somewhat similar to the one built to protect the harbor.

While the Board does not concur in the fear expressed by residents of Scituate that there is a liability of inundation across this beach and the marshes behind it into Cohasset harbor, it nevertheless is of opinion that building the proposed wall would prevent the rolling back of the beach.

The apprehensions of the town were expressed to the Board through a committee, who stated that so great was their feeling about the necessity of this protective work, the cost of which would exceed the balance of the appropriation, that the town would appropriate a sufficient sum, in addition to the available balance of the appropriation, to have it carried out in such form as the Board would require it to be done. This work will presumably be commenced in the early spring.

GREEN HARBOR.

Early in the summer a survey was made of the channel at Green Harbor which was excavated the previous year. As dredged, the channel was 60 feet wide on the bottom and 5 feet deep at low water. Near the outer ends of the jetties the banks had washed down, and thus had widened, although shoaled, the channel in that location; the inner portion of the channel was found to have suffered but little change.

The anchorage basin which was excavated above the Narrows had shoaled considerably at its inner end, where the current on the ebb tide washed down quantities of sand from farther up the harbor. These changes were not unexpected, but their extent could not be anticipated.

The improvements made have renewed the interest of the fishermen, yachtsmen and others, and during the season the fishermen put a number of naphtha launches into use. The channel, even with the shoaling which has taken place at the entrance, has substantially as much water as there was on the bar previous to the construction of the dike, and is giving great satisfaction.

The extreme high tide of Nov. 18, 1901, damaged a portion of the bulkhead, built at the inner end of the western jetty to prevent the sand from blowing and drifting into the harbor. This damage has been repaired at a small expense, in a manner which will prevent a recurrence of the trouble.

The total expenditure on the harbor since the passage of chapter 469 of the Acts of 1898, authorizing its improvement, is $65,790.47. On account of the settlement of a portion of the stone jetties, additional stone will be required to restore their original elevation.

OSTERVILLE.

In May an examination and survey was made of the channel at West Bay, Osterville, to determine what changes, if any, had taken place there. It was found that the depth of water at the entrance channel between the jetties and on the shoal at the end of the jetties had increased; and that the channel across the bay, while maintaining its depth of nearly 3 feet at mean low water throughout its length, had altered its bed somewhat, but was generally in good condition.

This harbor has been considerably used by pleasure boats during the past season. The worms have eaten the planks in some sections of the jetty to a considerable extent, and a few of them have been wholly eaten off. It was therefore determined to continue the work of strengthening the jetties by means of stone riprap, as had already been commenced, and a contract was made Sept. 17, 1901, with Eugene S. Belden of Hartford, Conn., to place 1,200 tons of stone in the jetties, at the price of $2.47 per ton. The whole length of the timber work is now protected by stone riprap, and it is not anticipated that any further expenditure will be required on these structures for a number of years.

The cost of the work done this year is a follows: —

Stone riprap, ...	$2,964 00
Surveys and supervision, ...	17 50
	$2,981 50

The total cost of the work is $20,865.39.

LAKE ANTHONY.

By chapter 399 of the Acts of 1901, the Board was authorized to expend a sum not exceeding $5,000 for dredging and other necessary work to improve the harbor at Lake Anthony, Cottage City.

In May a survey was made to determine the depth of water and character of the bottom in the harbor and its entrance. The stone jetties and entrance channel were found in good condition; a slight shoaling was found in the entrance channel about opposite the low-water mark on the beach outside of the jetties, but not, however, sufficient to reduce the navigable depth of the channel. The bottom of the harbor proper was found to consist of a considerable depth of soft mud, which supported a luxuriant growth of grass. It was learned that in the previous season vessels anchoring there had dragged anchors during severe squalls until they grounded.

An estimate was made of the cost of excavating this mud, in order to get good holding ground; but the quantity was so large that it could not be done with the available appropriation. It was also found that the approach to the landing wharf which had been built on the Cottage City side of the harbor was too shoal for use by the larger class of boats, and it was therefore decided, after conference with the local authorities, to confine the dredging to the excavations required to give boats free access to this wharf at all times, and to place ten heavy moorings in the harbor, to which yachts and vessels could be moored securely. The necessary stones, chains and buoys were purchased, and a contract made with George H. Cavanagh, whose plant was in that vicinity, to set the moorings and do all needful dredging for the sum of $2,500, also to remove any shoaling which had taken place in the entrance channel. The moorings were set early in the season, and the work completed in a satisfactory manner by Oct. 21, 1901. The material excavated was deposited on the adjacent shore, where, after being levelled down, it will form a smooth, steep beach, and greatly improve the shores of the lake.

At the suggestion of this Board a harbor master was appointed, who will take charge of and regulate the use of the moorings.

The cost of the work done this year is as follows: —

For moorings,	$296 63
For setting moorings and dredging,	2,500 00
Surveys and supervision,	66 88
Total,	$2,863 51

The total cost of the work is $24,290.64.

The United States lighthouse department has placed two lights at the ends of the jetties which were built by the Commonwealth, within an area 10 feet in diameter in the centre of the head of each jetty, which by request was conveyed to the United States under the provisions of section 7 of chapter 1 of the Public Statutes for the purpose of erecting and maintaining these lights. The structures were erected and the lights put in operation in August. The conveyance was made after consultation with the Attorney-General, who confirmed the authority of the Board to take action in a communication, of which the following is a copy: —

BOSTON, June 25, 1901.

Hon. WOODWARD EMERY, *Chairman, Board of Harbor and Land Commissioners.*

DEAR SIR: — Your letter of June 4 states that "under the provisions of Statutes of 1898, chapter 441, and Statutes of 1899, chapter 155, the Board of Harbor and Land Commissioners has cut a channel between Lake Anthony at Cottage City and Vineyard Sound, about 5 feet deep and 100 feet wide on the bottom, and has protected the same by building two stone jetties on either side of the cut, extending into the sound about 200 feet beyond the low-water mark, reaching a depth of about 8 feet at mean low water. . . . The United States Lighthouse Board is willing to maintain lights on the end of the jetties. The ends of the jetties are built up (as are the entire jetties) by loose stones piled up, between the interstices of which the water readily flows."

The question submitted by your letter is, whether the Board may convey the land upon which the ends of the jetties have been erected to the United States for the purpose of maintaining lights and lighthouses thereon, it being one of the provisions of the U. S. Revised Statutes that no lighthouse shall be erected on any site until "cession of jurisdiction over the same has been made to the United States."

The authority of your Board is to be found in Public Statutes, chapter 1, section 7, which provides: "The board of harbor and land commissioners, with the approval of the governor and council, may in the name and behalf of the Commonwealth convey to the United States the title of the Commonwealth to any tracts of land covered by navigable waters, and necessary for the purpose of erecting lighthouses, beacon lights, range lights, or other aids to navigation, or lightkeepers' dwellings, upon the application of any authorized agent or agents of the United States: *provided*, that such title shall revert to and revest in the Commonwealth whenever such land ceases to be used for such purposes." There can be no doubt that the circumstances of the case bring it within the provisions of this statute.

The jetties extend out 200 feet below low-water mark, and reach to a depth of 8 feet at mean low water. They are built of loose stones, through the interstices of which the water readily flows. The soil upon which the jetties rest is, therefore, the property of the Commonwealth, and title to it may be conveyed by your Board to the United States, under the statute quoted and subject to the conditions named therein.

Very truly yours, H. M. KNOWLTON,
Attorney-General.

MENAMSHA INLET.

In July an examination was made of the structures which have been built since 1897 at the mouth of Menamsha Inlet in Chilmark. The works generally were found in good condition, the entrance channel being larger than at any time since the construction of the jetties. The timber structure which had been built to the westward of the westerly jetty had caused the beach to build up, and prevented the sand from being driven into the channel so far as it extended; but beyond it, as the beach was built up, sand was driven through spaces between the stones of the jetty. These holes can be closed at slight expense.

On the easterly side the current has cut away the sand from behind the wing of the jetty which extended along the beach, and the river channel thus widened has shoaled to some extent.

Before doing anything, it was decided to make a survey, to determine the exact status of the situation, and this was done in September. The cutting in rear of the easterly wing jetty was increasing, therefore it was deemed advisable to make plans and estimates for straightening the channel of the creek, as was originally contemplated. The estimates, however, of the cost of doing all that would be necessary if once started, were so large as to preclude action by the Board without special authority. Since then in a heavy north-easterly storm a section of the wing jetty has been overthrown, and a large quantity of sand and gravel deposited in the channel. No danger that the water of the creek will break through and make another opening, however, need be apprehended.

The jetties at the entrance of this harbor were originally located at equal distances on either side of the boundary line between the towns of Chilmark and Gay Head, in substantially the middle of the outlet of the creek across the bar, at a point about 450 feet westerly from the bend where the main channel of the creek approached and ran along inside the beach; thus the creek, in flowing toward the beach along inside it and thence out through the jetties into the sound, turned at practically two right angles in its course.

In case it shall be thought best to carry out the project as originally planned, and secure the best results from the construction of the jetties, it will be necessary to excavate a channel across the flats from the entrance between the jetties toward the inner end of the bluff near the Tilton house, and to build two short jetties or training walls at either end of the excavated channel, to direct the current into it. To do this would tend to permanently deepen the entrance and enlarge the present harbor. The cost would probably not exceed the sum of $5,000.

The total amount expended is $9,952.20.

WITCHMERE HARBOR.

During a heavy south-west gale in the spring of 1901 a few of the stones in the western jetty, built by the Commonwealth in 1899 and 1900, were washed off and dropped into the channel. At the same time considerable quantities of sand were washed from the beach over the top of the jetty into the channel. In September these stones were replaced in the jetty, and a timber bulkhead built on the crest of the beach to prevent the sand from driving over the top of the jetty. The total expense of this work was as follows: —

Repairs and materials, ...	$99 04
Surveys and supervision, ...	26 80
Total, ...	$125 84

While this work was in progress a survey was made of the channel, which was found to have been scoured by the current, as was expected, and to a greater depth throughout its length than in the previous year.

The people living in the vicinity are much disturbed by the quantities of seaweed driven onto the beach and held there by the jetties. This is a serious interference with the use of the beach for bathing and its enjoyment by the summer visitors; but if the jetties were removed and the seaweed allowed to drift along the beach, large quantities would drive into the harbor and land just at the inner end of the entrance channel, as it did before the construction of the jetties. The decay of the seaweed lodging on the beach gives forth offensive odors. There seems, however, to be no remedy for the nuisance created by this collection of seaweed except by removing it.

This is a duty which the Board, when applied to by the selectmen, decided was beyond its scope, but suggested that possibly the stuff had a commercial value if removed from the water and dried, in which case the cost of doing the work might be repaid by the sale of the material, thus keeping the beach clean, and giving employment to a number of the inhabitants.

The total amount expended is $4,824.17.

Scorton Harbor.

An inspection and examination of the mouth of Scorton harbor was made in November last. The mouth, as was not unexpected, has been shoaled and diverted along the coast to the south-east, owing to the movement of material along that unprotected shore. It affords an instance of the necessity of protecting by jetties the mouth of rivers which debouch through a sandbar or spit. The action of the waves in stormy weather, stirring up the sand, and of the currents in moving the particles along and finally depositing them where there is less motion of the water, renders it futile to dredge an entrance in an exposed situation without thoroughly protecting it, as has been done by this Board at other outlets. The appropriation in this instance made no provision for jetty work.

The total amount expended is $2,948.47.

PLYMOUTH HARBOR.

In March the Boston, Plymouth & Provincetown Steamboat Company made request that a shoal in the channel of Plymouth harbor near the wharf on Long beach be removed. On March 25 to 28 a survey was made, and it was found that the point of a flat in this portion of the channel projected so far as to make passage difficult, and plans were made for dredging a sufficient quantity of material to enable vessels to round it in safety.

On April 20 a contract was made with the Harries & Letteney Company, the lowest bidder, to do the work, for 28 1-2 cents per cubic yard, and it was completed May 10, 1901.

The total cost of this work is as follows: —

Dredging,	$797 72
Surveys and supervision,	76 56
Total,	$874 28

The United States government in November of this year completed a dike of heavy riprap on Long beach, 10,468 feet in length, about 18 feet in height above mean low water, and containing 28,600 tons of stone. This work is of very substantial character, completely protecting the harbor, and was rendered necessary by the total destruction of all the government works along that part of the beach in the great storm of Nov. 27, 1898.

A test of the character of this new work was afforded in the severe storm of November 25 of the present year, when the gale, tide and surf approached at their maximum the conditions of 1898; yet the riprap withstood the heavy pounding of the sea without receiving damage at any point.

PROVINCETOWN HARBOR.

Although the importance of this harbor is such as to bring it within the care and supervision of the federal authorities, nevertheless, the Board exercises a watchful interest over its condition.

In April authority was granted the Boston, Plymouth & Provincetown Steamboat Company to dredge in Provincetown harbor for the improvement of the channel leading up to its wharf.

Early notice was received by the Board from its agent at Provincetown that the governmental protective works designed to prevent the influx of the ocean to the upper reaches of the harbor had been seriously impaired by the storm of November 25 last. The information was immediately transmitted to the federal authorities having charge of the works; as should, by any chance, the ocean make a breach through the thin neck of sand at the upper end of the harbor, the consequences, though unforseeable, could not but be injurious, if not destructive, to the harbor.

New Bedford Harbor Lines.

In pursuance of an order of the Legislature of Feb. 4, 1901, requiring the Board to investigate the advisability of changing the harbor lines on the westerly side of Fish Island in the harbor of New Bedford, a hearing was duly advertised and held at the city hall in New Bedford on February 19.

After a full hearing, at which an opportunity was given to every one desiring to be heard, the Board reported a bill changing the harbor line, which was subsequently enacted as chapter 243 of the Acts of 1901.

The change in the line will unquestionably be beneficial to shipping obliged to pass through the new draw between Fish Island and Pope's Island for the purpose of discharging at the wharves opposite Fish Island just above the old bridge.

Great Ponds.

The growing public taste for summer outing places has led to the occupation of the shores of great ponds and the islands to a degree never before experienced.

The title to and ownership of islands in great ponds often present questions of novelty and importance.

Application is not infrequently made to the Board for leases of such islands; and now and then the attention of the Board is directed to the occupancy of an island to which it is claimed the occupant has no title, but is squatting on the lands of the Commonwealth.

With reference to leasing the islands, the Board is inclined to view them as affording increased opportunity for public enjoyment of the rights secured by the Colony Ordinance of 1647 in the great ponds themselves, and not, therefore, as possessions to be appropriated to the exclusive and particular use and enjoyment of private individuals, and has consequently declined hitherto to grant leasehold interests to those petitioning for them.

Before taking action with reference to such islands as may appear to belong to the Commonwealth, but as to which the title is doubtful, the Board took the opinion of the Attorney-General, whose letter, addressed to the chairman, reads as follows: —

DEAR SIR: — Your letter of October 8 states that the Board of Harbor and Land Commissioners desires to be informed "whether or not islands in great ponds to which no private individual has title are property of the Commonwealth, with reference to the possession of which this Board has a duty to perform."

The term "great pond" has been used in the statutes of the Commonwealth from time immemorial. It originally signified an inland body of water, consisting of ten acres (Colony Ordinance of 1647); but this area was subsequently increased, in the case of the public right of fishing, to twenty acres. (Statutes of 1869, chapter 384, section 7.)

The original grants from the King, in the case of the Colony of Plymouth and the Colony of Massachusetts Bay as well, gave to the colony the title to all lands within the Commonwealth, including great ponds. This provision was also incorporated into the charter of the Province of Massachusetts Bay; and the title to such lands and ponds, unless previously parted with, was, both before and after the Revolution, in the State. "These charters [the several charters to the colonies and the Province] vested in the grantees not only the right of soil, but also large powers of government and the prerogatives of the crown in the sea shores, bays, inlets, rivers and other property which were held for the use and benefit of all the subjects." (Watuppa Reservoir Co. *v.* Fall River, 147 Mass. 548, 554. See also Commonwealth *v.* Roxbury, 9 Gray 451, 483; Commonwealth *v.* Alger, 7 Cush. 53.)

From a very early period the law of Massachusetts has treated great ponds as of a character closely resembling tide waters, the enjoyment of which for fishing, fowling and other purposes was common to all, and the title in and lands under which could not be made the subject of private ownership without special grant from the Legislature. (Paine *v.* Woods, 108 Mass. 160; Ancient Charters, 148, 149. See also Commonwealth *v.* Vincent, 108 Mass. 441; West Roxbury *v.* Stoddard, 7 Allen, 158.) Thus it was provided in the Colony Ordinance of 1641 that every inhabitant should have free fishing and fowling in any great ponds . . . within the precincts of the town where they dwelt, unless the freemen of the town or the General Court had provided otherwise. (Body of Liberties, 1641.) Later, it was provided that no town should appropriate to any person or persons any great pond containing more than ten acres. (Ordinance of 1647.)

These ordinances applied to all great ponds exceeding ten acres in area which in 1647 had not been appropriated to particular persons, either by the freemen of the town or by the General Court. (West Roxbury *v.* Stoddard, *supra.*) The Commonwealth therefore owns the great ponds as public property held in trust for public purposes. It has the ownership of the soil, including, obviously, the soil of islands within the area of such ponds, and also the right to control and regulate the public uses to which the ponds shall be applied. (Watuppa Reservoir Co. *v.* Fall River, 147 Mass. 557.) In such ponds a grant bounded by the pond extends only to low-water mark. (Waterman *v.* Johnson, 13 Pick. 261, 265; Paine *v.* Woods, 108 Mass. 160.) The proprietors of land bordering upon the ponds have no rights in the soil or in the waters, unless it be by grant from the Legislature. (Watuppa Reservoir Co. *v.* Fall River, 147 Mass. 557.)

It follows that the title to lands in great ponds is, in the absence of any grant from the Legislature or from the freemen of a town, prior to 1647, in the Commonwealth. Being lands the title to which is in the Commonwealth, the duties of your Board relating to the same are prescribed by Revised Laws, chapter 96, section 3.

Very truly yours, HOSEA M. KNOWLTON,
Attorney-General.

TOWN BOUNDARY SURVEY.

In June, the Board, under authority of chapter 469 of the Acts of 1901, assumed the duties pertaining to the Commission on the Topographical Survey and Map of Massachusetts, and has continued the work begun by that commission.

During the first part of the year, up to the time the Topographical Survey Commission was consolidated with this Board, the work was confined to working up the results from the field work of the previous year, and in preparing and superintending the printing of the boundary atlases.

Since then surveys have been made by one party to complete the location of the boundaries in eleven towns in Norfolk County, including the surveys of streams and roads forming boundaries between these and adjoining towns. Another party was employed on similar work in Barnstable, Essex and Middlesex counties a portion of the time, and the balance of the time on the surveys for the Taunton River and Boston harbor canal. The office force has been employed in the preparation of the town boundary atlases, and in calculating the location of the town corners from data furnished by the work of the field parties. The calculations of the position of the town corners determined between the years 1893 and 1900, which were delayed, awaiting the completion of the primary triangulation work on which it was based, have been completed and the location of the corners filed in the card catalogue. The compilation of the statutes defining the boundaries of thirty-four towns has been completed.

Since January 1, atlases of one city and three towns have been published, viz., Springfield, Raynham, Norton and Rehoboth; and atlases of two towns, Arlington and Sandwich, which were partly printed in June, are now in press.

The plan of publication has been changed so as to materially reduce the expense. Instead of publishing an atlas of each town, adjacent towns are grouped together and published in one atlas, and the printing of the pictures of the bounds at the town corners is omitted.

One atlas including the towns of Cohasset, Hingham, Hull and Weymouth, has been prepared, and is now in press.

The town boundary work done during the year has been less than the year before, owing to the diversion of a portion of the employees to the surveys for the Taunton River and Boston harbor canal; but by transferring the employees from one class of work to another, all necessary results of interest to the Commonwealth have been accomplished.

Sale of Maps.

During the year, under chapter 57 of the Resolves of 1890, 14 atlases, one folio and 2,527 additional sheets of the State topographical maps have been sold, for $187.40.

Under chapter 360 of the Acts of 1900, 4 town boundary atlases have been sold for $15, and 3 Rhode Island and Massachusetts boundary line plans for $0.96. Two hundred and sixteen atlases were sent to the officers of the various cities and towns, as provided by law. Under chapter 95 of the Resolves of 1891, 10 atlases and 2 extra portfolios have been distributed, 5 of these being sent to free public libraries. The proceeds of the above sales have been paid to the State Treasurer. It was voted to send a set of town boundary atlases to the U. S. Coast and Geodetic Survey office.

The bounds to mark the portions of the boundary lines between the city of Marlborough and the town of Southborough, between the towns of Carver and Wareham, and between the towns of Lynnfield and Saugus, as established by chapters 393, 394 and 407 of the Acts of 1901, have been set by the local authorities, and plans for filing with the Secretary of the Commonwealth, provided for in the various acts, are being prepared.

STATE BOUNDARIES.

During the year the monuments marking the boundary line between Massachusetts and New Hampshire which were found to be missing or to have been displaced when the line was perambulated last year, have been set and replaced.

The monument on Salisbury beach, which was washed out by the storm of November, 1898, was reset in its original location at a lower grade. The Boston & Maine Railroad set certain monuments which were reported displaced, one at the Merrimac branch, and the other at the Nashua & Acton branch of its road; and also furnished and set a new monument at the intersection of the boundary line with its western division main line. These were subsequently examined, and found to be set in the proper location. The filling was replaced around the monument at the Townsend Hill road between Townsend, Mass., and Brookline, N. H., where it had been cut away by the water in flowing down the road. Where the boundary line crosses Lake Monomonac, between the towns of Winchendon, Mass., and Rindge, N. H., the line was not marked for a distance of 6,697 feet. The shores of the lake are being rapidly occupied by summer cottages.

At the suggestion of Hon. J. B. Tennant, of the Governor's Council of New Hampshire, to whom was delegated the duty of co-operating with the Board in this work, it was decided to place three additional monuments along that line: First, a granite monument, similar to those already set on this section of the line, at a point 1,476 feet east of the monument at the road on the westerly side of the lake. Second, a cast-iron post, at a point 3,108 feet further east. This iron post is of the same pattern as those set on the line between Massachusetts and New York. At a point 426 feet east of this post is a wrought-iron bolt, which is set in a small boulder on the line. Third, a stake has been set to mark the location for the third monument, at a point 938 feet east of the cast-iron monument and 1,179 feet west of the monument at the road on the easterly side of the lake. As this point is difficult of access except across the lake, the setting of the monument has been postponed until this winter, when it can be transported on a sled across the ice. The monument is of granite, and similar to the others on this portion of the line, and will be set as soon as the weather permits.

Owing to the pressure of other duties, nothing has been done toward replacing the monuments on the line between Massachusetts and Rhode Island, which were found to be displaced or missing when the line was perambulated last year, but it is proposed to do this work the coming season. Upon its completion the line between Massachusetts and Connecticut will be the only portion of the boundary of the State not fully marked in a permanent manner; and some arrangement should be made to re-run and mark this line, whenever the State of Connecticut shall be ready to take up the matter.

In the report of the Commission on the Topographical Survey and Map of Massachusetts for 1898, the cost of relocating and marking the Connecticut line was estimated to be $14,000, of which one-half should be paid by each State. This estimate was based on the cost of the work which had been done by them in relocating and marking the line between Massachusetts and New York.

Amount paid into treasury by the Commission on the Topographical Survey and Map of Massachusetts from sale of maps, etc., from Jan. 1, 1901, to June 7, 1901, inclusive, . .	$104 95
Amount paid into treasury by Harbor and Land Commission from sale of maps, etc, from June 8, 1901, to Nov. 30, 1901, inclusive, ...	98 41
Total, ...	$203 36

PROVINCE LANDS.

Three years ago the Legislature appropriated $10,000 to be spent during the succeeding three years in the improvement of the Province Lands.

It is now eight years since the care of the Province Lands was committed to the Board for reclamation. In that time the Legislature has appropriated $23,000. With the expenditure of that money about 170 acres of the blowing sands have been reclaimed and protected from movement by the violence of the winds. Also from that fund a much-needed road, about 10,200 feet long, has been built across the sand barrens to the Race Point life-saving station, at a cost of about $3,450, or a little less than 34 cents a running foot.

The reports of the superintendent under whose supervision this work has been performed have been published in the annual reports of the Board from year to year. Their perusal will show the steady although necessarily slow improvement which has been effected during the period of his care.

The progress of the work has been viewed by scientific men from the agrostological department at Washington and elsewhere with great interest. The results have fully answered expectations, and the method of reclamation adopted has met with unqualified approval.

In order to complete the work, it will be desirable to reclaim about 115 acres more of the sand barrens, after which there need be no apprehension of danger from the blowing of the sands on the lands of the Commonwealth. The shrubs and young trees are growing up among the beach grass, and are doing extremely well.

The sum of $68.36 has been collected during the season, and turned over to the Treasurer of the Commonwealth.

The appropriation is exhausted to an unexpended balance in the treasury of 21 cents, and, unless renewed at the coming session of the Legislature, further improvement and care of the lands will have to be discontinued.

The report* of the Superintendent of the Province Lands may be found in the Appendix.

WRECKS.

Under chapter 260 of the Acts of 1883, the Board is authorized to remove wrecks and other obstructions from tide waters. The work done during the year is as follows: —

A portion of a small vessel lying on the water pipes of the Metropolitan Water Board was removed from Chelsea Creek in March and April, under an agreement with Alfred S. Sorensen, at a cost of $50.

Forty-seven ancient piles, forming part of the old bridge which formerly connected the westerly end of Breed's Island with Chelsea, and was removed many years ago, were complained of as causing an obstruction to navigation in Chelsea Creek, and were taken up in April, under an agreement with W. H. Wyman, at a cost of $228.

A large boulder in Charles River, opposite Hoosac Tunnel docks, liable to cause wrecks, was removed in May, under an agreement with Geo. W. Townsend, at a cost of $75.

On July 23 a request was received from the city engineer of Gloucester for an inspection of Gloucester harbor, with a view to removing certain ledges and boulders which were obstructing navigation. After a conference with the city engineer, August 15, it appeared that the boulders complained of were situated at the entrance to a private slip, where they obstructed the passage of vessels only to and from that particular wharf; the Board therefore did not consider it to be a case that called for action by the State. The ledges complained of were found to be so large and extensive that the Board did not feel justified in undertaking their removal without further legislation.

In September complaint was received that in rebuilding the bridge in the highway between Wareham and Marion, over the Weweantitt River, the contractor had broken or cut off the piles of the old bridge at or about the level of low water, and that a considerable number of them were a serious obstruction, and dangerous to small boats passing under the new bridge. After investigation, the matter was brought to the attention of the State Highway Commission, under whose direction the work was being done, and the obstructions were removed.

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* See Appendix C.

Also a large boulder projecting above the bottom of Boston harbor, at a point about 50 feet from the southerly corner of Central wharf, was removed in October, under an agreement with Geo. W. Townsend, at a cost of $46.

The attention of the Board was called to the fact that the wharf of the Plymouth Stove Company at Plymouth was in a dilapidated condition, and rapidly being washed away by the sea into the channel. Upon notice to the company that injury threatened the channel, repairs were finally made.

SURVEYS.

The work done by the Engineering Department during the last year has been larger than that of any previous year, and the number of employees has been proportionately increased during the summer season.

In addition to the work on the Commonwealth flats at South Boston, special surveys were made of the mouth of Bass River in Dennis and Yarmouth, Herring River in Harwich, and Apponagansett harbor in Dartmouth, under the Resolves of 1901, with a view to determining what improvements could be made at these places; also a survey, under chapter 104 of the Resolves of 1901, for the purpose of estimating the probable cost of constructing a canal from Taunton River to Boston harbor, which included the examination and mapping of the route, 40 miles long.

Other surveys have been made in connection with the general work of the Board, as follows: —

In December, 1900, the surveys of Bird Island shoal, as a basis for making plans for an anchorage basin, were completed.

December 13, a survey was made of the area which had been dredged as a berth for the nautical training ship

"Enterprise" at North End Park, to ascertain if the excavation had been properly completed.

December 19, a survey was made to ascertain the amount of filling which had been placed by the contractor in rear of the concrete sea wall built at the Sand Hills in Scituate.

In December, 1900, and January, 1901, surveys were made of a portion of Fort Point Channel, from Congress Street bridge to Rowe's wharf, preparatory to contracting for dredging to a depth sufficient to accommodate the increased size of vessels coming to the wharves in this locality. In May surveys of the same territory were made upon the completion of the dredging.

January 2 and 4, a survey was made to ascertain the extent of certain obstructions caused by piles in an old bridge which formerly crossed Chelsea Creek, opposite Breed's Island.

February 5, levels were taken to ascertain the elevation of the bench marks which had been placed on Congress Street bridge by the superintendent, showing the heights reached by the water during storms.

In February, March and April, the plane table survey of Mystic River was continued, some of the earlier sheets of the river were corrected and brought up to date in locations where extensive changes and improvements had been made, and two additional sheets completed.

March 25 to 28, a survey was made of the channel in Plymouth harbor, at the point just south of Long Beach, with a view to straightening the channel by cutting off a portion of the bend.

In April and June, surveys were made at Point Shirley and Shirley Gut, preparatory to excavating the shoaling which had taken place, also of the location of the dredging which had been done.

May 9 to 14, a survey was made of the channel of Winthrop harbor, to ascertain the location of shoals.

May 16 to 18, a survey was made of the channel which had been excavated into West Bay at Osterville, to determine what changes had taken place.

May 27 to 30, a survey was made at Lake Anthony, in Cottage City, as a basis for planning the work of excavating the anchorage, and of the approaches to the landing.

May 29, a survey was made of property on Chelsea Creek, in Chelsea, formerly owned by White, Holman & Co., to ascertain the amount of tide water which had been displaced. June 10 to 12, a survey was made of the entrance channel at Green Harbor, to determine what changes had taken place.

June 25 to 27, a survey was made of Stony beach, in Hull, preparatory to making plans for a sea wall to protect the beach.

In August, September and October surveys were made relative to the work of improvement at Lake Anthony.

September 16, a survey was made of the embankment which the Old Colony Railroad Company had built across South Bay, to ascertain the amount of tide water which had been displaced thereby.

September 19 to 21, a survey was made of Menamsha Creek, in Chilmark, to determine what changes had taken place since the construction of jetties by the Commonwealth.

October 31, a survey was made of shoals in Boston harbor near Union wharf.

INSPECTIONS MADE BY THE BOARD DURING THE YEAR.

1900.		
Dec.	7.	Commonwealth flats at South Boston.
1901.		
Feb.	4.	Stony beach, in Hull, in company with legislative committee, relative to proposed protective works.
Mar.	22.	Boston harbor and proposed anchorage ground at Bird Island shoal, in company with legislative committee.
Mar.	29.	Commonwealth flats at South Boston.
April	5–6.	Entrance to Bass River, in Dennis and Yarmouth, under authority of chapter 39 of the Resolves of 1901.
		Jetties and channel at Osterville, relative to condition of work done under direction of the Board.
April	9.	Protective works on the Connecticut River, in Hadley and Northampton.
April	17.	Commonwealth flats at South Boston.
April	25.	Work in progress at Union wharf.
April	29.	Site of proposed structures in Buzzards Bay, at Monument beach.

1901.	
April 30.	Work in progress on survey of entrance to Bass River, in Dennis and Yarmouth, authorized by chapter 39 of the Resolves of 1901.
May 2–3.	Banks of the Connecticut River, in Northampton and Hadley, with legislative committee, relative to protective work.
May 4.	Work done at outlet of Maquan Pond, in Hanson.
May 8.	Wharf property of the Boston Fire Brick and Clay Retort Manufacturing Company and the Boston Electric Light Company, at L Street, in South Boston.
May 9.	Commonwealth flats at South Boston, and proposed site of Northern Avenue and bridge, in company with legislative committee.
May 17.	Concrete sea wall on the beach at the Sand Hills, in Scituate, built under direction of the Board; also other localities in Scituate where it is desired to have the Board do certain work under chapter 434 of the Acts of 1900.
	New mouth of North River, in Scituate.
May 24–25.	Witchmere harbor, in Harwich, relative to condition of work done under direction of the Board.
	Herring River, in Harwich, relative to improvement authorized by chapter 66 of the Resolves of 1901.
	Entrance to Bass River.
	Jetties and channel at West Bay, in Osterville.
May 28.	Structure in tide water near the railroad station at West Manchester, on complaint made by property owners.
June 7.	Site of proposed work of New England Gas and Coke Company on Island End River, in Everett.
June 29.	Work done by the Commonwealth on the Province Lands in Provincetown.
July 12–13.	Apponagansett harbor, relative to survey authorized by chapter 38 of the Resolves of 1901, and Lake Anthony, in Cottage City, relative to further improvements.
July 16.	Location for canal near Brockton, under chapter 104 of the Resolves of 1901.
July 18–19.	Banks of the Connecticut River at Northampton and Hadley, relative to a continuation of the protective work in Hadley authorized by chapter 94 of the Resolves of 1901.

1901.	
July 23.	Stony beach in Hull, relative to location of sea wall authorized by chapter 483 of the Acts of 1901.
	Location of proposed canal line between Weymouth and Holbrook.
July 25.	Work of filling the parkway on Charles River, near Brookline bridge, in Cambridge.
July 31.	Location of proposed canal line between Taunton and West Bridgewater.
Aug. 5.	Structures in Lake Chaubunagungamaug, in Webster.
Aug. 6.	Commonwealth flats at South Boston.
Aug. 14–15.	Work of setting buoys and dredging in Lake Anthony, at Cottage City.
	Jetties and channel at Menamsha Inlet, relative to work done under direction of the Board.
Aug. 19.	Work of placing a monument on Salisbury beach, marking the boundary line between Massachusetts and New Hampshire.
Aug. 25.	Jetties and channel at West Bay, Osterville, relative to work done under the direction of the Board.
Aug. 27.	Structures projecting beyond the harbor line on Merrimac River, in Haverhill.
Aug. 28.	Bridges over Weweantitt River and Wankinco River, in Wareham.
Aug. 29–30.	Protective work in progress on the bank of the Connecticut River at Hadley, under direction of the Board, and work done at West Springfield.
Sept. 4.	Commonwealth flats at South Boston.
Sept. 9.	Work done under the direction of the Board at Witchmere harbor, in Harwich; entrance to Bass River, in Dennis and Yarmouth, relative to further surveys.
Sept. 12.	Lake Anthony, in Cottage City, relative to work in progress, under direction of the Board.
Sept. 24.	Work in progress on survey for proposed canal between Taunton and Somerset.
Sept. 26.	Cedar Pond and Dunham Pond, in Carver, relative to petitions for authority to take water from said ponds for flowing cranberry bogs.
Sept. 28.	Protective work in progress on the bank of the Connecticut River in Hadley, under direction of the Board.
Oct. 3.	Ragged Island in Hingham harbor.
Oct. 11.	Commonwealth flats at South Boston.

1901.

Oct.	18.	Work done by the Commonwealth on the Province Lands in Provincetown.
Oct.	19.	East Bay in Osterville.
Oct.	22.	Property of Fore River Ship and Engine Company, on Weymouth Fore River, in Quincy.
Oct.	23.	Commonwealth flats at South Boston.
Oct.	24.	Structures and sites of proposed sewer outlets in Plymouth harbor.
Oct.	26.	Protective work in progress on the bank of the Connecticut River in Hadley, under direction of the Board.
Nov.	9.	Mouth of Scorton harbor, in Sandwich, relative to condition of work done under authority of chapter 442 of the Acts of 1898.

LICENSES GRANTED DURING THE YEAR.

Nos.

2434. Petition of Jens Bertelsen and John P. Petersen for license to fill solid in Boston harbor at East Boston. Granted Dec. 3, 1900.

2435. Petition of the Boston & Albany Railroad, the New York Central & Hudson River Railroad Company, lessee, for license to reconstruct a portion of the westerly side of its Pier No. 1 in Boston harbor at East Boston. Granted Dec. 4, 1900.

2436. Petition of the Suburban Gas and Electric Company for license to build and maintain a pile wharf, construct a crib, lay pipes and dredge a basin in Chelsea Creek in the town of Revere. Granted Dec. 27, 1900.

2437. Petition of the Lynn & Boston Railroad Company for license to dump snow and ice into Mystic River from Chelsea bridge over the north channel of said river. Granted Jan. 7, 1901.

2438. Petition of Matthew J. Connors and James E. Cavanagh for license to build and maintain a pile wharf and dredge a channel in Weymouth Fore River at Hough's Neck in the city of Quincy. Granted Jan. 7, 1901.

2439. Petition of Michael J. Kane for license to build and maintain an ice run in Dorothy Pond in the town of Millbury. Granted Jan. 7, 1901.

2440. Petition of Hannah G. Shaw for license to build and maintain retaining walls and fill solid in East River in the town of Wareham. Granted Jan. 7, 1901.

Nos.

2441. Petition of Nathan F. Tufts and others for license to build a bulkhead and fill solid in Mystic River, adjoining Charlestown Park, in the city of Boston. Granted Jan. 7, 1901.

2442. Petition of the Boston & Albany Railroad, the New York Central & Hudson River Railroad Company, lessee, for license to widen and extend its Pier No. 7 in Boston harbor at East Boston. Granted Jan. 7, 1901.

2443. Petition of Henry W. Smith for license to build a bulkhead and fill solid in Chelsea Creek, adjoining Marginal Street, in the city of Chelsea. Granted Jan. 7, 1901.

2444. Petition of Cashman Brothers for license to build a bulkhead and pile fenders, to extend wharf and fill solid in Merrimac River in the city of Newburyport. Granted Jan. 7, 1901.

2445. Petition of Albin Leal Richards for license to fill solid in Mystic River at his wharf adjoining Medford Street in the city of Boston. Granted Jan. 9, 1901.

2446. Petition of Henry H. Fay for license to build and maintain a wharf, partly solid and partly on piles, in Wood's Hole Great Harbor, at Wood's Hole in the town of Falmouth. Granted Jan. 11, 1901.

2447. Petition of Willard Howland for license to fill solid and build a pile platform in Chelsea Creek at East Boston. Granted Jan. 25, 1901.

2448. Petition of the Trustees of Fiske Wharf and Warehouse Trust for license to build a bulkhead and pile structure and fill solid in a dock adjoining Fiske wharf in the city of Boston. Granted Feb. 4, 1901.

2449. Petition of the Board of Metropolitan Sewerage Commissioners for approval of plans for constructing a sea wall and pile platform, and for filling solid in Chelsea Creek at East Boston, as authorized by chapter 439 of the Acts of 1899. Granted Feb. 28, 1901.

2450. Petition of the Boston Electric Light Company for approval of plans for laying a cable across Fort Point Channel at Dover Street bridge in the city of Boston, under authority of chapter 249 of the Acts of 1898. Granted Feb. 28, 1901.

2451. Petition of the Board of Metropolitan Park Commissioners for license to excavate, fill solid and change the southwesterly shore line of Charles River, in the city of Boston, from near Boylston Street bridge to a point opposite the Cambridge Hospital grounds. Granted Feb. 28, 1901.

Nos.

2452. Petition of the city of Boston for license to build a pile wharf for the support of a coal shed in Boston harbor at the South Ferry in East Boston. Granted Feb. 28, 1901.

2453. Petition of the Metropolitan Steamship Company for license to widen and extend Union wharf on piles in Boston harbor in the city of Boston. Granted Feb. 28, 1901.

2454. Petition of Job L. Cole for license to build and maintain an ice run in Fresh Pond in the town of Plymouth. Granted Feb. 28, 1901.

2455. Petition of the Boston Fire Brick and Clay Retort Manufacturing Company for license to extend two pile wharves and fill solid in Boston harbor, near the Reserved Channel at South Boston. Granted March 7, 1901.

2456. Petition of Edward W. Chadwick for license to extend his pile pier in Edgartown harbor at Chappaquiddick in the town of Edgartown. Granted March 7, 1901.

2457. Petition of the Massachusetts Pipe Line Gas Company for approval of plans for building pile structures and laying a gas main in, over and under Island End River in the cities of Everett and Chelsea, under authority of chapter 537 of the Acts of 1896. Granted March 7, 1901.

2459. Petition of the South Bay Company for license to fill solid in South Bay in the city of Boston. Granted March 15, 1901.

2460. Petition of the Hanley Construction Company for license to build and maintain a wharf, partly solid and partly on piles, on Town River in the city of Quincy. Granted March 18, 1901.

2461. Petition of the Boston & Albany Railroad, the New York Central & Hudson River Railroad Company, lessee, for license to rebuild its sea wall at the head of Dock No. 1, Grand Junction wharves, at East Boston. Granted March 18, 1901.

2462. Petition of the city of Boston for license to widen Alford Street by filling solid, and to riprap the slope of said filling in Mystic River in the city of Boston. Granted March 18, 1901.

2463. Petition of Thomas E. Reed for license to widen and extend his wharf, on piles, in Gloucester harbor in the city of Gloucester. Granted March 18, 1901.

2464. Petition of Catherine A. Meston for license to build and maintain a pier in Mattapoisett harbor in the town of Mattapoisett. Granted March 18, 1901.

Nos.

2465. Petition of the New Bedford & Onset Street Railway Company for license to fill solid in Wareham River in the town of Wareham. Granted March 20, 1901.

2466. Petition of Julia W. Lowry for license to build and maintain a pile pier and float stage in Buzzards Bay at Josiah's Point in the town of Wareham. Granted March 25, 1901.

2467. Petition of Frederic S. Goodwin for license to extend his wharf, on piles, in Boston harbor at East Boston. Granted March 29, 1901.

2468. Petition of the Providence & Fall River Street Railway Company for license to build a pile bridge across Palmer's River and to fill solid in adjacent creeks in the town of Swansea. Granted April 3, 1901.

2469. Petition of the Boston & Albany Railroad, the New York Central & Hudson River Railroad Company, lessee, for license to enlarge its Pier No. 1 and Dock No. 2 and build a sea wall and pile platform in Boston harbor at East Boston. Granted April 4, 1901.

2470. Petition of the Trustees of the Hingham and Quincy Bridges for license to widen a portion of the present bridge on Weymouth Back River in the town of Hingham. Granted April 4, 1901.

2471. Petition of the town of Ipswich for license to build a sea wall and fill solid in Ipswich River in the town of Ipswich. Granted April 5, 1901.

2472. Petition of the city of Boston for license to rebuild the piers and wharves, on piles, at the East Boston landing of the South Ferry in Boston harbor. Granted April 15, 1901.

2473. Petition of the Metropolitan Water and Sewerage Board for approval of plans for laying pipes in Boston harbor from Nut Island, building a pile wharf and constructing embankments, in the city of Quincy and town of Hull, as directed by chapter 424 of the Acts of 1899. Granted April 17, 1901.

2474. Petition of William H. Norton for license to build and maintain a pile pier in Edgartown harbor in the town of Edgartown. Granted April 17, 1901.

2475. Petition of the Massachusetts Highway Commission, acting under authority of chapter 497 of the Acts of 1894 and acts amendatory thereto, for license to rebuild two bridges over the Weweantitt River in the towns of Marion and Wareham. Granted April 30, 1901.

Nos.

2476. Petition of Frank Stanwood for license to extend his wharf, on piles, in Gloucester harbor in the city of Gloucester. Granted April 30, 1901.

2477. Petition of the Board of Park Commissioners of Arlington for license to build a dam, sluiceway and screen at the mouth of Mill Brook at Mystic Lake in the town of Arlington. Granted April 30, 1901.

2478. Petition of the town of Marblehead for license to build a sea wall and fill solid in Nick's Cove in the town of Marblehead. Granted May 3, 1901.

2479. Petition of the town of Bourne for license to build a sea wall and fill solid in Cohasset Narrows in the town of Bourne. Granted May 3, 1901.

2480. Petition of William F. Macy and John P. Fitts for license to build and maintain a pile wharf in Quincy Bay at Hough's Neck in the city of Quincy, and to dredge a basin and channel leading to said wharf. Granted May 3, 1901.

2481. Petition of Alfred S. Sorensen for license to build a wharf, partly solid and partly on piles, in Chelsea Creek, adjoining Marginal Street in the city of Chelsea. Granted May 10, 1901.

2482. Petition of George H. Richards and Howard Stockton, trustees of the Toby Club, for license to build and maintain a pile wharf, ways, dolphins and landing float, and to dredge in Buzzards Bay at Monument beach in the town of Bourne. Granted May 10, 1901.

2483. Petition of the Corinthian Yacht Club for license to build and maintain a wharf and landing stage in Marblehead harbor at Marblehead Neck in the town of Marblehead. Granted May 10, 1901.

2484. Petition of William H. Moore and Edwin C. Swift for license to build and maintain a pile pier and float, also to lay and maintain an iron pipe for drainage purposes in Salem harbor in the city of Beverly. Granted May 10, 1901.

2485. Petition of Albin Leal Richards for license to fill solid and extend his wharf, on piles, in Mystic River in the city of Boston. Granted May 10, 1901.

2486. Petition of the city of Cambridge, by its Board of Park Commissioners, for license to fill solid in Charles River, between points 240 feet east and 670 feet west of Putnam Avenue. Granted May 10, 1901.

Nos.

2487. Petition of Benjamin F. Brown, trustee, the heirs of Nancy Lennon, Henry O. Marcy, Jennie G. Carter, Noah S. King, James A. Norcross and Orlando W. Norcross, for license to fill solid in Charles River between land of the Boston & Albany Railroad Company and land of Charles H. Souther and others in the city of Cambridge. Granted May 10, 1901.

2488. Petition of the city of Boston for license to repair and reconstruct the draw landing and fender on the South Boston side of Mt. Washington Avenue bridge on Fort Point Channel. Granted May 10, 1901.

2489. Petition of Eugene T. Adams and James F. Ring, co-partners under the firm name of Simonds & Adams, for license to build a sea wall and fill solid in Merrimac River in the city of Haverhill. Granted May 13, 1901.

2490. Petition of Reed & Gamage for license to build and maintain a pile wharf in Gloucester harbor in the city of Gloucester. Granted May 14, 1901.

2491. Petition of George F. Welch for license to widen and extend his wharf in Scituate harbor in the town of Scituate. Granted May 14, 1901.

2492. Petition of Samuel W. K. Brooks for license to rebuild, widen and extend his wharf, on piles, and to build launch ways in Boston harbor at Harbor View, East Boston. Granted May 16, 1901.

2493. Petition of the city of Boston for license to drive additional piles in the middle pier of the North Ferry, Boston landing. Granted May 27, 1901.

2494. Petition of the Gloucester Fish Drying Company for license to build and maintain a pile pier on Annisquam River in the city of Gloucester. Granted May 27, 1901.

2495. Petition of Robert W. Emmons, 2d, for license to build and maintain two pile piers and floats in Buzzards Bay at Mashnee Island. Granted June 3, 1901.

2496. Petition of the town of Wareham for license to rebuild and widen the highway bridge across the Wankinco River at Wareham Narrows. Granted June 3, 1901.

2497. Petition of the New Bedford & Onset Street Railway Company for approval of plans for building a pile bridge over the Wareham River at the Narrows, below the present highway bridge and westerly of and adjacent to the location of the New York, New Haven & Hartford Railroad Company, as authorized by chapter 132 of the Acts of 1901. Granted June 5, 1901.

Nos.

2498. Petition of the Brockton & Plymouth Street Railway Company for license to build and maintain a runway, on piles, and a float in Little Sandy Bottom Pond in the town of Pembroke. Granted June 5, 1901.

2499. Petition of the town of Marblehead for license to build a wharf in Marblehead harbor at Red Stone Cove. Granted June 12, 1901.

2500. Petition of Jennie W. Bliss for license to build and maintain a pile pier and float in Marion harbor in the town of Marion. Granted June 12, 1901.

2501. Petition of the Soule Mill for license to build bulkheads and fill solid in Acushnet River in the city of New Bedford. Granted June 14, 1901.

2502. Petition of the Board of Public Works of the city of New Bedford for license to build and maintain a six-foot brick sewer, on piles, in Acushnet River, in extension of the sewer built in Sawyer Street, in the city of New Bedford. Granted June 14, 1901.

2503. Petition of Edwin A. Grozier for license to build and maintain a boat house on piles at the south-easterly end of Central wharf in Provincetown harbor in the town of Provincetown. Granted June 14, 1901.

2504. Petition of the Middleborough, Wareham & Buzzards Bay Street Railway Company for approval of plans for building a pile bridge over Swift's River at Point Independence in the town of Wareham, as authorized by chapter 344 of the Acts of 1901. Granted June 19, 1901.

2505. Petition of the Middleborough, Wareham & Buzzards Bay Street Railway Company for approval of plans for building a pile bridge over Buttermilk Bay in the towns of Wareham and Bourne, as authorized by chapter 344 of the Acts of 1901. Granted June 19, 1901.

2506. Petition of the Brockton & Plymouth Street Railway Company for license to place poles in Plymouth harbor in the town of Plymouth, for the purpose of an overhead transmission line. Granted June 20, 1901.

2507. Petition of the Edison Electric Illuminating Company of Boston for license to build a sea wall and fill solid in Fort Point Channel in the city of Boston. Granted June 24, 1901.

2508. Petition of Henry A. Leonard, trustee, for license to build a wharf in Buzzards Bay in the town of Dartmouth. Granted June 26, 1901.

Nos.

2509. Petition of Grace F. Allen for license to build a pile pier in Little Sandy Bottom Pond in the town of Pembroke. Granted June 26, 1901.

2510. Petition of James F. Smith, trustee, for license to build and maintain a pile pier in Priest's Cove at Pope beach in the town of Fairhaven. Granted June 26, 1901.

2511. Petition of the East Boston Athletic Association Boat Club for license to drive piles for the support of a boat house in Chelsea Creek, adjoining Meridian Street bridge at East Boston, and to maintain runways, a float and a floating bath house. Granted June 26, 1901.

2512. Petition of Felix Rackemann for license to build and maintain a pile pier and floats in Katama Bay in the town of Edgartown. Granted July 3, 1901.

2513. Petition of the Misery Island Club for license to build and maintain a pile pier and float in Salem harbor at Misery Island. Granted July 3, 1901.

2514. Petition of Cornelia S. Chapin for license to build a pile pier in Edgartown harbor in the town of Edgartown. Granted July 3, 1901.

2515. Petition of the Edison Electric Illuminating Company of Boston for license to extend its wharf, on piles, on Fort Point Channel in the city of Boston. Granted July 3, 1901.

2516. Petition of the Metropolitan Steamship Company for license to build a sea wall and to remove a portion of Union wharf in Boston harbor in the city of Boston. Granted July 3, 1901.

2517. Petition of the estate of John Manners for license to build a timber wharf and fill solid in Merrimac River in the city of Haverhill. Granted July 8, 1901.

2518. Petition of the city of Haverhill for license to build a timber wharf and fill solid in Merrimac River in the city of Haverhill. Granted July 8, 1901.

2519. Petition of Stefano Gardella for license to build a timber wharf and fill solid in Merrimac River in the city of Haverhill. Granted July 8, 1901.

2520. Petition of the city of Boston for approval of plans for building a temporary foot-bridge and fender across Fort Point Channel at Broadway bridge, under authority of chapter 452 of the Acts of 1900. Granted July 8, 1901.

Nos.

2521. Petition of the East Boston Gas Company for approval of plans for building a pile structure for the support of a gas main across Chelsea Creek in the city of Boston and town of Winthrop, under authority of chapter 228 of the Acts of 1901. Granted July 10, 1901.

2522. Petition of the Board of Metropolitan Park Commissioners for license to fill solid in Charles River and change the northerly shore line in the town of Watertown, between points 2,500 and 3,900 feet westerly from North Beacon Street bridge. Granted July 16, 1901.

2523. Petition of the United States Steel Company for license to build a bulkhead and fill solid in a creek flowing into Malden River in the city of Everett. Granted July 18, 1901.

2524. Petition of Alice V. McAloon for license to build and maintain a pile pier and float stage in Buzzards Bay at Long Neck in the town of Wareham. Granted July 18, 1901.

2525. Petition of the Philadelphia & Reading Coal and Iron Company for license to build a sea wall and fill solid in a dock on Acushnet River in the city of New Bedford. Granted July 29, 1901.

2526. Petition of the New Bedford Gas and Edison Light Company for license to build a sea wall and fill solid in a dock on Acushnet River in the city of New Bedford. Granted July 29, 1901.

2527. Petition of the Quincy Electric Light and Power Company for license to extend its wharf, on piles, and to dredge in Town River in the city of Quincy. Granted July 29, 1901.

2528. Petition of Caroline E. Bates for license to build a pier in Buzzards Bay in the town of Dartmouth. Granted July 29, 1901.

2529. Petition of the West End Street Railway Company for license to build bulkheads and fill solid in Chelsea Creek at East Boston. Granted July 31, 1901.

2530. Petition of the West End Street Railway Company for license to build a sea wall or bulkhead and pile wharf and fill solid in Mystic River at Charlestown in the city of Boston. Granted July 31, 1901.

2531. Petition of the Boston Elevated Railway Company for license to build a sea wall and concrete piers, fill solid, widen its wharf on piles, and dredge in Boston harbor at Lincoln wharf in the city of Boston. Granted July 31, 1901.

Nos.

2532. Petition of Edward N. Pigot for license to build and maintain a pile pier and float in Buzzards Bay in the town of Wareham. Granted Sept. 10, 1901.

2533. Petition of Arthur M. Phillips for license to build and maintain a pile pier and float stage in Onset Bay in the town of Wareham. Granted Sept. 10, 1901.

2534. Petition of the Beacon Park Company for license to maintain a pile and timber wharf, also a pile wharf and floats, in Lake Chaubunagungamaug in the town of Webster. Granted Sept. 10, 1901.

2535. Petition of Robert G. Shaw for license to build and maintain a pile wharf in Vineyard Haven harbor at West Chop in the town of Tisbury. Granted Sept. 10, 1901.

2536. Petition of the Hanley Construction Company for license to build pile structures in Town River in the city of Quincy. Granted Sept. 10, 1901.

2537. Petition of the city of Gloucester for approval of plans for laying a water pipe across Squam River in the city of Gloucester, under authority of chapter 451 of the Acts of 1895. Granted Sept. 23, 1901.

2538. Petition of the Boston & Albany Railroad, the New York Central & Hudson River Railroad Company, lessee, for license to remove Pier No. 3, Grand Junction wharves, and to enlarge and reconstruct Pier No. 4 and adjoining dock, in Boston harbor at East Boston. Granted Sept. 23, 1901.

2539. Petition of the city of Boston for approval of plans for building a temporary foot-bridge across Fort Point Channel at Broadway bridge in the city of Boston, under authority of chapter 452 of the Acts of 1900. Granted Sept. 25, 1901.

2540. Petition of Robert Treat Paine, 2d, trustee, for license to build a boat landing in Massachusetts Bay in the town of Manchester. Granted Sept. 25, 1901.

2541. Petition of David B. Newcomb, Jr., for license to build a sea wall or dam across the entrance to a dock in Sandy Bay in the town of Rockport. Granted Oct. 2, 1901.

2542. Petition of Albert C. Burrage for license to build a pile wharf in Boston harbor at Bumkin Island in the town of Hull. Granted Oct. 2, 1901.

2543. Petition of the town of Dartmouth for approval of plans for reconstructing the bridge over the Apponagansett River at the village of South Dartmouth, under authority of chapter 384 of the Acts of 1901. Granted Oct. 2, 1901.

Nos.

2544. Petition of the Orient Heights Yacht Club for license to drive piles in Boston harbor at East Boston, for the support of a club house. Granted Oct. 3, 1901.

2545. Petition of the Boston, Revere Beach & Lynn Railroad Company for license to fill solid a portion of its pile bridge, to rebuild a portion of the same and construct a double-track trestle, in Crystal Cove in the town of Winthrop. Granted Oct. 7, 1901.

2546. Petition of the county commissioners of Norfolk County for approval of plans for constructing a bridge, with approaches, across Weymouth Fore River, substantially replacing the present bridge at Quincy Point, under authority of chapter 456 of the Acts of 1900. Granted Oct. 9, 1901.

2547. Petition of Robert Winsor for license to build and maintain a pile pier and float and a marine railway, also to fill solid, in Red Brook harbor at Rocky Island in the town of Bourne. Granted Oct. 10, 1901.

2548. Petition of the East Boston Dry Dock Company for license to widen and rebuild, on piles, a portion of its northerly pier in Boston harbor at East Boston. Granted Oct. 10, 1901.

2549. Petition of the Boston Elevated Railway Company for license to dump snow and ice into tide waters. Granted Oct. 29, 1901.

2550. Petition of the Union Freight Railroad Company for license to dump snow and ice into Charles River from the yard of the Fitchburg Railroad Company at the foot of Haverhill Street in the city of Boston. Granted Oct. 29, 1901.

2551. Petition of Peter T. Fallon and others for license to build a sea wall and fill solid in Town River in the city of Quincy. Granted Oct. 29, 1901.

2552. Petition of Ensign K. Tewksbury and others for license to fill solid in the basin north of Washington Avenue in the town of Winthrop. Granted Oct. 30, 1901.

2553. Petition of the Middleborough, Wareham & Buzzards Bay Street Railway Company for license to extend the easterly abutment of the bridge across Swift's River at Point Independence in the town of Wareham. Granted Nov. 5, 1901.

2554. Petition of the New Bedford Yacht Club for license to build and maintain a pile pier and float stage in Apponagansett harbor in the town of Dartmouth. Granted Nov. 5, 1901.

Nos.

2555. Petition of the county commissioners of Essex County for approval of plans for constructing a new bridge and approaches across Merrimac River between the city of Newburyport and the town of Salisbury, under the provisions of chapter 483 of the Acts of 1896 and chapters 517 and 526 of the Acts of 1901. Granted Nov. 8, 1901.

2556. Petition of the city of Boston for license to dump snow and ice into tide waters. Granted Nov. 11, 1901.

2557. Petition of the Fore River Ship and Engine Company for license to build wharves, piers, marine railway, and to fill solid and dredge in Weymouth Fore River and Bent's Creek in the city of Quincy. Granted Nov. 14, 1901.

2558. Petition of the Boston & Maine Railroad for license to extend Pier No. 5, Hoosac Tunnel docks, on piles, on Charles River in the city of Boston. Granted Nov. 27, 1901.

PETITIONS DENIED.

On Dec. 19, 1900, in the matter of the petition of Albin Leal Richards for license to build two pile wharves and a bulkhead, and to fill solid on Mystic River in Charlestown, the Board declined to grant a license in the manner and form requested by the petitioner, but subsequently a license was granted in modified form, upon filing an amended plan.

On January 16, S. A. Thayer and Wm. M. Stetson, petitioners for license to fill solid in Great Pond in the town of Braintree, were granted leave to withdraw, as the town, represented by the selectmen, and the water board, opposed the granting of a license, on the ground that the Legislature has authorized the use of the waters of this pond for domestic purposes and that the granting of the desired license would be detrimental to public interests.

On February 11, Walter S. Gordon, petitioner for lease of an island in Morse's Pond in Wellesley, was given leave to withdraw, as the granting of an exclusive use of the same would be contrary to public policy.

On April 12, the Board refused to authorize the Bay State Dredging Company to dump material dredged from Nantasket Channel on flats lying between White Head and Strawberry Hill, in Hull, being of the opinion that the material should be dumped at sea.

On April 30, the Board declined to lease an island in the town of Billerica.

On May 13, the Board declined to permit the removal of material from Green Island in Boston harbor.

On June 4, the Board declined to permit the removal of material from a beach in Marblehead harbor.

On June 12, George L. Stacy, petitioner for license to build a wall and fill solid in Wonson's Cove, in Gloucester, was granted leave to withdraw, the title of the petitioner to the land in question being in dispute.

On July 1, the Board, acting with the Railroad Commissioners, as a joint Board, refused to grant the petition of the Boston, Cape Cod & New York Canal Company for authority to issue stock and bonds, as previously stated on page 56.

On August 1, the Board declined to approve an amendment of section 3, chapter 38 of the Revised Ordinances of the city of Boston, relating to the passage of vessels through the draw in Charlestown bridge, on Charles River, as previously stated on page 23.

On August 15, the Board declined to remove certain boulders from Gloucester harbor, located at the entrance to a private slip, as previously stated on page 83.

On October 9, the Board decided, after full hearing, to take no action at present on the petition of Z. A. Tillson & Son, asking that license No. 1360, granted by the Board to Peleg McFarlin, authorizing the building of structures and drawing of water from Cedar Pond in Carver, be revoked.

MISCELLANEOUS PERMITS GRANTED DURING THE YEAR.

POINT SHIRLEY CLUB, to dredge gravel from its flats at Point Shirley, in the town of Winthrop. Granted Dec. 3, 1900.

NEW ENGLAND DREDGING COMPANY, to dredge not exceeding 100,000 cubic yards of gravel in Boston harbor westerly of Lovell's Island. Granted Dec. 20, 1900.

J. N. SMITH & CO., to use a portion of the Commonwealth flats at South Boston for storage purposes. Granted Jan. 1, 1901.

PETER MCCONARTY, to use a portion of the Commonwealth flats at South Boston for storage purposes. Granted Jan. 1, 1901.

ESTATE OF PATRICK O'RIORDEN, to use a portion of the Commonwealth flats at South Boston for storage purposes. Granted Jan. 1, 1901.

Edith Andrew, and Edith Andrew as trustee, to remove gravel from the beach at the south-easterly end of Prince's Head, a part of Peddock's Island in Boston harbor. Granted Feb. 14, 1901.

Trustees of the Main Street Land Trust, to dredge material from their flats in Charles River, on the Cambridge side of the channel, near West Boston bridge. Granted Feb. 18, 1901.

Samuel James, 2d, to remove stone from the beach at Sheep Island in Boston harbor. Granted Feb. 28, 1901.

City of Haverhill, to lay and maintain a cable on the bottom of Merrimac River, across the drawways in Haverhill bridge. Granted March 8, 1901.

Joseph L. Boardman, to remove gravel from Salter's beach at Gurnet Point, in the town of Plymouth. Granted March 25, 1901.

Town of Hadley, to repair and protect the banks of the Connecticut River in Hadley. Granted April 12, 1901.

Cole Brothers, to dump material dredged at the site of the New Bedford and Fairhaven bridge, at North Ledge in New Bedford harbor. Granted April 15, 1901.

Boston, Plymouth & Provincetown Steamboat Company, to dredge in Provincetown and Plymouth harbors. Granted April 25, 1901.

New England Telephone and Telegraph Company, to maintain its poles on the easterly side of E Street, on the Commonwealth flats at South Boston. Granted May 6, 1901.

W. C. Bramwell, to remove gravel and material from the beach at Skull Head, in the town of Hull. Granted May 9, 1901.

Albin Leal Richards, to construct a temporary pile platform on Mystic River, in the city of Boston. Granted May 10, 1901.

Boston, Plymouth & Provincetown Steamboat Company, to dump material dredged from Provincetown harbor at a point south of Long Point Light. Granted May 16, 1901.

Moses Williams, to dredge in Cedar Pond Creek, in the town of Bourne. Granted May 16, 1901.

William J. Tilley, to remove gravel from the beach bordering on Quincy Bay at Hough's Neck, in the city of Quincy. Granted May 22, 1901.

Samuel T. Humphrey, to remove stones from the beach southerly of the causeway connecting Marblehead and Marblehead Neck. Granted May 29, 1901.

Bay State Dredging Company, to dump material dredged in Chelsea Creek on flats northerly of Orient Heights near Chain bridge. Granted June 14, 1901.

Atlantic Club, to remove sand and gravel from the beach in front of upland belonging to said club at Point Allerton, in the town of Hull. Granted June 19, 1901.

Quincy Yacht Club, to dredge flats in Boston harbor at Hough's Neck, in the city of Quincy. Granted June 20, 1901.

Charles H. Sawyer and William F. Macy, to dredge flats and a channel in Town River Bay, in the city of Quincy. Granted July 3, 1901.

Fanny C. Adams, to dredge gravel from Half Moon Island in Quincy Bay, in the city of Quincy. Granted July 3, 1901.

John G. Hall & Co., to use a portion of the flats in the Reserved Channel adjacent to the Commonwealth flats, for the storage of logs; to erect, for temporary use, two dolphins in tide water; to erect an engine and derrick on land between the Reserved Channel and E Street. Granted July 3, 1901.

John S. Ballou, to remove material from Ragged Island, in Boston harbor. Granted July 12, 1901.

Mary A. Harvey, to dredge a channel through flats in Quincy Bay at Hough's Neck, in the city of Quincy. Granted July 18, 1901.

Bay State Dredging Company, to dredge material in Shirley Gut from the shoal extending out from Deer Island. Granted July 29, 1901.

Eastern Dredging Company, to dredge material from Mystic River, between Malden bridge and the Eastern Railroad bridge, also between Middlesex Avenue bridge and Foster's ship yard. Granted Aug. 1, 1901.

Eastern Dredging Company, to dredge gravel from Boston harbor near Lovell's Island. Granted Aug. 2, 1901.

Bay State Dredging Company, to dredge material from Boston harbor near the south-westerly point of Deer Island. Granted Aug. 13, 1901.

Frank J. Hannon, to use a frontage of the sea wall on the northerly side of the Reserved Channel, on the Commonwealth flats at South Boston, for landing, storing and removing gravel. Granted Aug. 14, 1901.

Thomas Meany, to use a frontage of the sea wall on the northerly side of the proposed Northern Avenue, easterly of the Commonwealth pier at South Boston, for landing, storing and removing sand and gravel. Granted Aug. 20, 1901.

Nantasket Beach Steamboat Company, to remove sand from the berths and around Pemberton pier in Hull. Granted Oct. 14, 1901.

COLE BROTHERS, to dump material excavated for the foundation of the bridge over Apponagansett River in Dartmouth, at Bent's Ledge in New Bedford harbor. Granted Oct. 31, 1901.

ISAAC BLAIR & CO., to dump snow from Dover Street bridge into tide water in the city of Boston. Granted Nov. 25, 1901.

WORK OF THE UNITED STATES IN RIVERS AND HARBORS OF THE COMMONWEALTH.

The Board is indebted to Lieut.-Col. W. S. Stanton and Capt. Harry Taylor, Corps of Engineers, U. S. A., who are in charge of river and harbor improvements in eastern Massachusetts, and Maj. Geo. W. Goethals, Corps of Engineers, U. S. A., who is in charge of similar work in southern Massachusetts, for the following statements, which show the work accomplished in the rivers and harbors of this Commonwealth during the fiscal year ending June 30, 1901: —

STATEMENT OF LIEUT.-COL. W. S. STANTON, CORPS OF ENGINEERS, U. S. A.

BOSTON, MASS., Dec. 13, 1901.

Board of Harbor and Land Commissioners, Commonwealth of Massachusetts, Boston, Mass.

SIRS: — In accordance with your request of Dec. 2, 1901, I have the honor to furnish the following summary of work done by the United States during the fiscal year ending June 30, 1901, in the rivers and harbors of Massachusetts in my district.

The works of improvement under my charge on June 30, 1901, were: —

1. Lynn harbor.
2. Boston harbor.
3. Chelsea Creek.
4. Mystic River, below mouth of Island End River.
5. Mystic and Malden rivers.
6. Charles River.
7. Weymouth ("Fore" and "Back") River.
8. Town River.
9. Scituate harbor.
10. Duxbury harbor.
11. Plymouth harbor.
12. Provincetown harbor.
13. Chatham harbor.
14. Examinations and surveys.
15. Wrecks.

Operations upon these works during the last fiscal year have been as follows: —

Boston Harbor.

Works of preservation: repairs were made to the sea walls on Rainsford and Castle islands.

Works of improvement: 554,503.5 cubic yards of material were dredged, and 3,200 cubic yards of ledge were blasted and removed from the upper main ship channel; and 206,090 cubic yards of material were dredged from Broad Sound Channel.

Mystic and Malden Rivers.

No work was done in the section of Mystic River embraced in this improvement.

In Malden River, 13,576 cubic yards of material were removed during the fiscal year, in restoring the authorized depth of 12 feet at mean high water in the channel.

Mystic River, below the Mouth of Island End River.

From this section of Mystic River, 86,511 cubic yards of material were dredged, giving a depth of 25 feet at mean low water in the channel.

Scituate Harbor.

During the latter part of the fiscal year, 1,583.5 cubic yards of gravel were dredged from a shoal that had encroached upon the dredged channel near the wharves.

Plymouth Harbor.

Construction of the riprap dike on Long beach was continued, and 3,391.5 linear feet were built, containing 12,256.75 tons of stone.

Provincetown Harbor.

Five hundred and fifty-three linear feet of plank bulkhead were built for the preservation of the beach at Abel Hill dike.

Chatham Harbor.

No work was done, but at the close of the fiscal year a contract was in force for dredging a channel 6 feet deep at low water, and at the date of this statement the work has been completed.

Examinations and Surveys.

On Nov. 19, 1900, a report was submitted upon a survey of Lynn harbor, recommending the dredging of a channel 200 feet wide, 15 feet deep at mean low water, at an estimated cost of $162,936.84. The report was published as House Document, No. 78, fifty-sixth Congress, second session.

On Nov. 28, 1900, a report was submitted upon a survey of Boston harbor, together with a project for deepening the main ship channel to 35 feet at mean low water from the Charles River and Chelsea bridges to the sea, through Broad Sound, at an estimated cost of $10,612,710.46. The report was published as House Document, No. 119, fifty-sixth Congress, second session.

No work has been done during the fiscal year in Lynn harbor, Town, Weymouth, Chelsea and Charles rivers, or in removal of wrecks.

Very respectfully, W. S. STANTON,
Lieutenant-Colonel, Corps of Engineers.

STATEMENT OF CAPT. HARRY TAYLOR, CORPS OF ENGINEERS, U. S. A.

BOSTON, MASS., Dec. 17, 1901.

Board of Harbor and Land Commissioners, Boston, Mass.

GENTLEMEN: — In accordance with request contained in your letter of the 2d instant, I have the honor to furnish the following summary of the work done by the United States during the fiscal year ending June 30, 1901, in the rivers and harbors of Massachusetts under my charge: —

Newburyport Harbor.

No operations were in progress, other than making a survey of the bar at the entrance of the harbor. This survey shows that there has been some improvement in the depth of water over the bar, the controlling depth in 1901 being 12.6 feet at mean low water, as against 11 feet at mean low water in 1899, when the last previous survey was made. The channel had moved slightly to the north of its 1899 position, but retained about the same width that it had at that time.

Merrimac River.

The present approved project for the improvement of this river provides for a channel 150 feet wide and 7 feet deep at mean low water (ordinary low water stage of the river), from Newburyport to Haverhill. The first work under this project was begun in June, 1901, and at the close of the fiscal year the channel had been dredged 90 feet wide and full depth from a point just below Haverhill for a distance of 1,100 feet down river.

Powow River.

At the beginning of the fiscal year a channel 12 feet deep at mean high water and 45 feet wide had been dredged from the head of navigation at Amesbury for a distance of about 6,050 feet down river. From this point to the mouth of the river the channel was 30 feet wide. During the past fiscal year the 45 foot width of channel has been extended nearly down to the highway bridge at Salisbury Point, where a section about 650 feet long still remains to be done. This section is at least 30 feet wide.

Essex River.

At the beginning of the fiscal year the channel had been dredged to its full projected depth, 60 feet wide, for a distance of 400 feet below the highway bridge in Essex, and at least 25 feet wide for the remainder of the distance to its lower end. During the fiscal year the project for the improvement of this river was completed, the improved channel now being 60 feet wide and at least 4 feet deep from the mouth of the river up to the highway bridge at Essex.

Harbor of Refuge, Sandy Bay, Cape Ann, Mass.

During the fiscal year operations have been continued in the construction of the substructure of the breakwater. During the year a total of 107,680 tons of rubblestone was placed in the breakwater. The substructure of the southern arm of the breakwater is now completed to mean low water, except for a distance of about 70 feet. A section of about 100 feet of substructure on the western arm was raised to mean low water during the year.

Gloucester Harbor.

At the beginning of the fiscal year a section of about 1,650 feet of the substructure of the breakwater had been completed to full proposed dimensions. The operations of the past fiscal year consisted in the construction of superstructure. The work commenced at the shore end of the breakwater at Eastern Point, and the superstructure was completed for a distance of 284 linear feet. A 3-inch steel spindle for the support of a light, which the Light-House Establishment proposed to maintain, was erected on the outer end of the substructure of the breakwater.

Examination and Survey.

Under the provisions of the emergency river and harbor act approved June 6, 1900, a preliminary examination and survey was made of Beverly harbor, with a view to obtaining a channel 200 feet wide and 18 feet deep at mean low water.

From a survey in 1899 it was found that this harbor possessed an available channel of 18 feet depth at mean low water to the wharves of the town, but the claim had been made recently that this channel had deteriorated materially. The present survey, however, made in September, 1900, shows that, while no material shoaling has taken place, the width of the 18-foot channel is so narrow at certain points as to make it difficult to take heavy coal vessels through without touching on one side or the other. It was recommended that a limited amount of dredging be done, estimated to cost about $10,000, in order to give a clear channel width of about 200 feet.

No work was in progress during the fiscal year on any of the other Massachusetts works in my charge.

Very respectfully, HARRY TAYLOR,
Captain, Corps of Engineers.

STATEMENT OF MAJ. GEO. W. GOETHALS, CORPS OF ENGINEERS, U. S. A.

NEWPORT, R. I., Dec. 5, 1901.

Board of Harbor and Land Commissioners, Commonwealth of Massachusetts, State House, Boston, Mass.

GENTLEMEN: — In compliance with your request of Dec. 2, 1901, I forward herewith a summary of work done by the United States during the fiscal year ending June 30, 1901, in the rivers and harbors of Massachusetts.

Very respectfully, GEO. W. GOETHALS,
Major, Corps of Engineers, U. S. A.

Abstract of the work of river and harbor improvement in the State of Massachusetts by the United States government, under the direction of Maj. Geo. W. Goethals, corps of engineers, U. S. A., for the fiscal year ending June 30, 1901: —

Hyannis Harbor.

No operations have been in progress during the past fiscal year.

This project contemplates the dredging of an area of 36 acres, protected by the breakwater to a depth of 15.5 feet. Of this area, about 26.6 acres have been dredged and two cuts 25 feet wide and 13 feet deep have been dredged in to the wharf of the New York, New Haven & Hartford Railroad Company.

Nantucket Harbor.

No operations have been in progress during the past fiscal year.

This project contemplates the construction of two jetties as training walls, one on each side of the harbor entrance, planned so as to allow the tidal currents to assist in scouring out and maintaining a good channel, and for the completion of the work by dredging where necessary to obtain a depth of from 12 to 15 feet at low water in this channel. The west jetty has been built for a distance of 4,955 feet, and the east jetty 4,840 feet, from the initial points on shore. Portions of both jetties are still to be built up to their projected cross-sections. There is now a depth of 8 feet in the channel, which, before improvement, was limited to 6 feet.

Vineyard Haven.

No operations have been in progress during the past fiscal year.

An examination of the harbor, with a view to its further protection and improvement as a harbor of refuge, by a breakwater, or otherwise, was made in September, 1899, and report thereon submitted to Congress, and printed as House Document, No. 66, fifty-sixth Congress, first session; it was also printed at page 1289, Annual Report of the Chief of Engineers, for 1900. In this report it is recommended that Congress be asked to authorize a general investigation of the question of a harbor of refuge for Vineyard and Nantucket sounds, with a view to determining the best location for such a harbor.

Wood's Hole Channel.

No operations have been in progress during the past fiscal year.

The existing project provides for deepening the channel through the strait to 13 feet at mean low water, and widening the same to 300 feet. There is now a fairly good channel of one-half the projected width, 150 feet and 13 feet depth through the strait; but a few shoal spots west of the junction of the two branches of the channel need to be removed to complete the southern half of the channel.

New Bedford Harbor.

No operations have been in progress during the past fiscal year.

The existing projects provide for dredging an anchorage basin ½ mile long, 600 feet wide and 18 feet deep at mean low tide, on the north side of the channel leading from Fairhaven to New Bedford; also for dredging a channel 250 feet wide and 18 feet deep from the anchorage basin through the new drawbridge between Fish and Pope's islands, to the deep water above. About .6 of the anchorage basin has been dredged; also the entire channel leading through the drawbridge; but, owing to the very soft character of the material through which the latter was dredged, the full depth has not been maintained throughout its width.

Eighteen feet of water may now be carried from the deep water of Buzzards Bay through the drawbridge.

Taunton River.

No operations were in progress during the past fiscal year.

The existing project contemplates dredging a channel so that it shall have a width of 100 feet and depth of 12 feet from the mouth of the river up to Berkley bridge; thence 12 feet depth and 80 feet width up to Briggs shoal; thence 11 feet depth with the same width up to the ship yard; thence 11 feet depth with 60 feet width up to Weir bridge, the depths all being referred to mean high water. This project is essentially completed, but there are a few points at which the channel requires widening.

Fall River.

No operations were in progress during the past fiscal year.

The existing project provides for a channel 300 feet wide and 25 feet deep at mean low water, along the city front between the deep water just below the Old Colony wharf and the deep water at the upper end of the harbor. The lower reach of this channel, extending from its lower end up to the Staples Coal Company's wharf, and comprising about one-half of the projected work, has been completed.

Removal of Wrecks.

During the fiscal year, the following wrecks were removed, so as no longer to form obstructions to navigation.

Schooners "Laura Robinson" and "David Siner" from the vicinity of Pollock Rip Light Ship, and the British steamer "Ardanhu" from Vineyard Sound near Robinson's Hole.

HARBOR COMPENSATION FUND.

There was paid into the treasury of the Commonwealth during the year, under sections 14 and 16 of chapter 19, Public Statutes, and chapter 146, Acts of 1897, in payment for tide water displaced by work done under licenses granted by the Board, and for rights and privileges granted in tide waters and great ponds, the sum of $29,475.11, which was credited to the harbor compensation fund for Boston harbor. The amount in this fund on Nov. 30, 1901, was $357,864.66; the income from this fund on the same date was $19,891.47.

COMMONWEALTH'S FLATS IMPROVEMENT FUND.

The balance in the Commonwealth's flats improvement fund on the first day of December, 1900, was $622,830.65. To this has been added during the year $22,781.56 from the income of the fund and $30,282.55 from sales and rents of lands and other sources, making a total of $675,894.76. Of this sum, there has been expended during the year $70,598.51, leaving a balance on Nov. 30, 1901, of $605,296.25.

TAUNTON RIVER AND BOSTON HARBOR CANAL.

Chapter 104 of the Resolves of 1901 directed the Board to make surveys and estimates as to the probable cost of constructing a ship canal from Narragansett Bay through Taunton, Brockton and Weymouth to Boston harbor, by way of Weymouth Fore River, and to report thereon to the General Court now sitting.

The depth and width of the proposed canal were apparently left to the judgment of the Board. A uniform depth of 25 feet and a width of 130 feet on the bottom, with side slopes of 1 on 2 in earth, and 180 feet with vertical sides where rock is encountered, have been fixed for the dimensions of the trunk of the canal.

A general location was determined from a study of the topographical maps, base lines were run, and a topographic and hydrographic survey was made for a distance of not less than 500 feet on either side for the entire distance from Weymouth Fore River to Slade's Ferry bridge near the mouth of Taunton River, with levels on the same and on cross-sections 500 feet apart. Other necessary levels were run and tidal observations made. The plane of reference of the survey was established at 1.5 feet below the mean sea level at Boston.

The results of these surveys were plotted on large scale plans, and contours drawn, showing every difference of 2 feet in elevation over the area surveyed. After a careful study of the information accumulated, a route was finally adopted.

The total length of the canal upon which the estimates are based between the ends of the approach structures of the tidal locks is 31.79 miles, of which 7.24 miles are on curves, the radii varying from 5,000 to 10,000 feet, and 2.22 miles of shorter radii, none, however, less than 2,000 feet. In fixing the line, due regard was had to economical construction.

Provision is made for 14 locks, 6 between Boston harbor and the summit level and 8 between there and the dam in Taunton River, with lifts varying from 7 to 25 feet. On the basis of 20 lockages a day, 33,000,000 cubic feet of water will be required for the daily operation of the locks.

A careful examination of the water supply and of the different methods of providing the necessary amount of water led to the adoption of a pumping system, as being the most advisable. The water surface of the summit level lies between Brockton and Randolph. The summit level is 16,000 feet long, at an elevation of 130 feet.

Two masonry dams are planned at the two ends of the canal; across Taunton River and Weymouth Fore River, respectively, opposite the tidal locks, to maintain the water in the rivers at high tide level.

The proposed line of the canal crosses the railroad at eleven places; it is proposed to avoid five of these by diverting the location of the tracks, and two of the others are drawbridges at the present time. It also crosses forty-six highways, of which a number are avoided by a rearrangement in such manner that the distance to be travelled will not be materially increased. Twenty drawbridges will cross the canal in most of which a clear width of 100 feet is provided for the passage of vessels.

Wherever the water level of the canal rises above the adjacent country, the side embankments are planned with puddle walls of clay; but where it runs through earth, a protection of broken stone, extending from 5 feet above to 5 feet below the water level, will be provided. Turning basins are proposed at Taunton, Brockton and Holbrook, approximately 600 feet square.

The cost of a sufficient right of way has been estimated. All estimates are based on unit prices, carefully considered;

and yet allowance must be made, owing to the brief time permitted for the examination of so large an undertaking. The total cost is estimated at $57,618,358.

A full report by the engineer * of the Board, together with plans of location and profile, may be found in the Appendix.

The foregoing report is respectfully submitted.

WOODWARD EMERY,
CHARLES C. DOTEN,
GEORGE E. SMITH,
Commissioners.

DEC. 1, 1901.

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* See Appendix D.

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APPENDIX.

APPENDIX.

[A.]

[See page 4 of this report, *ante*.]

CONTRACTS.

The contracts entered into during the year are as follows: —

1901.		
Feb. 14.	With the Bay State Dredging Company, for dredging in Fort Point Channel, Boston harbor, between Congress Street bridge and Rowe's wharf, for the sum of 25 cents per cubic yard of material, measured in scows, — amounting to	$14,317 25
March 7.	With William J. Lawler, for building a sea wall on the Commonwealth flats, at South Boston, for the sum of $56.49 for each lineal foot of completed sea wall, — estimated to amount to .	76,300 00
April 20.	With the Harries & Letteney Company, for dredging in Plymouth harbor, near Long beach, for the sum of 28½ cents per cubic yard of material, measured in scows, — amounting to	797 72
May 16.	With the Bay State Dredging Company, for dredging in Shirley Gut, Boston harbor, for the sum of $1,000, and in addition the sum of 35 cents for each cubic yard of material, measured in place, dredged and deposited on the Commonwealth pier at South Boston, — amounting to .	5,429 60
May 31.	With Thomas Meany, for moving and grading gravel on the Commonwealth pier, at South Boston, for the sum of 30 cents for each cubic yard of material moved, measured in the fill, — amounting to	3,796 80
July 16.	With George H. Cavanagh, for dredging a portion of Lake Anthony, at Cottage City, and setting buoys, — amounting to	2,500 00
July 30.	With Thomas H. Kiely, for furnishing riprap stone on the bank of the Connecticut River, at Hadley, for the sum of $1.67 for each cubic yard of stone delivered, — amounting to . .	5,888 09

1901.

Sept. 6.	With the Eastern Dredging Company, for dredging a portion of the dock on the westerly side of the Commonwealth pier, at South Boston, for the sum of 22½ cents for each cubic yard of material, measured in scows, — estimated to amount to	$15,500 00
Sept. 17.	With Eugene S. Belden, for strengthening the jetties built under the direction of the Board, at Osterville, for the sum of $2.47 for each ton of stone placed in the work, — amounting to .	2,964 00
Nov. 14.	With Augustus Bellevue & Co., for building jetties and dredging channel at the mouth of Bass River, in Dennis and Yarmouth, — estimated to amount to	20,307 60
Nov. 22.	With the New England Dredging Company, for dredging in Boston harbor, near Union wharf, for the sum of 32⅞ cents for each cubic yard of material measured in scows, — amounting to .	4,217 53
	Total amount, ...	$152,018 59

[B.]

[See page 26 of this report, *ante*.]

REPORT OF ENGINEER IN CHARGE OF CONNECTICUT RIVER WORK.

To the Honorable Board of Harbor and Land Commissioners of Massachusetts, WOODWARD EMERY, Esq., *Chairman.*

GENTLEMEN: — Following the instructions and authority given me by your vote of July 11, 1901, in carrying out the provisions of chapter 94 of the Resolves of 1901, relating to the further protection of the easterly bank of the Connecticut River in the town of Hadley, I have completed the season's work therein contemplated, and submit the following report thereon: —

The section of river bank protected by this year's operations extends from the northerly end of the section treated in 1900, up the river to Coleman's Brook, so called, a distance of 1,455 feet.

The plan adopted last year, at the suggestion of your engineer, Mr. Hodgdon, of a continuous matting of poles and willows, interwoven for the submerged part of the work, has been followed this year, with very satisfactory results. A description in detail of methods employed seems unnecessary here, as it would simply be a repetition of what has already been given in former reports.

The contract for stone for riprapping, made by you with Thomas H. Kiely of Northampton, has been faithfully carried out on his part, the stone having been delivered promptly, and of the required dimensions.

The quantity delivered was 3,525.8 cubic yards, at a cost of $5,888.09.

Active operations were commenced July 15, and the work completed November 5.

The area covered by mats and riprapping is 19,989 square yards, and the total cost has been $10,660.78, which is 53⅓ cents per square yard. The above total includes surveys, plan and estimate for a proposed dike below the highway bridge over the river between Hadley and Northampton.

The protective work has been carried into the ravine of Coleman's Brook a sufficient distance to prevent any damage to the banks by the action of waves or currents of the river. Proper connection has also been made at the lower end of this season's work with that completed in 1900.

With but one or two exceptions, local help has been employed on the work, under the immediate supervision of Roswell S. Gaylord, whose recognized ability and good judgment have contributed largely to the economical prosecution of the work.

The scows and lumber used on the work are piled up and roofed over on land of C. P. Wood, at the head of Front Street. The tools, tool box, ropes, etc., are housed in R. S. Gaylord's barn.

You will undoubtedly direct that young willows be set in this season's work at a suitable time next spring to complete the work, as has been done in years past.

The protective works built from year to year under your direction are now completed from the head of Front Street, in Hadley, around the "high banks," so called, to Coleman's Brook, a distance of 5,100 feet, and afford a continuous line of protection for the main part of the town from further encroachments of the river between the points named. Above and below these points there is no pronounced erosion of the banks, and I am confident that no further expenditures will be necessary for years to come on this part of the river.

The inhabitants of the town of Hadley fully appreciate the work that has been done for them, under your supervision, for the protection of the business part of their town, and the danger, so long manifest, by the yearly encroachments of the river at the head of their principal streets, it is believed, has been successfully met and overcome.

A serious break occurred in the river bank, below the highway bridge above referred to, during the high water of last spring. In company with your Mr. Hodgdon, this matter was examined, together with its probable effect on the adjacent lands, and a dike was suggested, extending from the highway to the river bank, as a preventive of further damage at this place. Surveys have been made for this dike, and a plan and estimate of the cost were submitted to you July 27, 1901. If it is decided to build this dike another year, the town of Hadley will undoubtedly take the necessary steps to secure a title to the land where it is proposed to locate it, and the material with which to build it.

Respectfully submitted,

E. C. DAVIS,
Engineer and Superintendent.

NORTHAMPTON, MASS., NOV. 9, 1901.

[C.]

[See page 82 of this report, *ante*.]

REPORT OF THE SUPERINTENDENT, PROVINCE LANDS.

PROVINCETOWN, MASS., Nov. 30, 1901.

To the Board of Harbor and Land Commissioners.

GENTLEMEN: — As Superintendent of the Province Lands, I respectfully submit the following report for the year ending Nov. 30, 1901: —

The first work of the season, about the middle of March, was the construction of a road, beginning at the point to which it had been built up to the close of the season of 1900, and continuing the same to its terminus at the outer beach of the reservation, a distance of about 1,900 feet, at a cost of $745 or about 40 cents per running foot, the increased cost over that of last year being on account of the greater distance to cart the material.

This road makes a very acceptable driveway across the reservation, a distance of about 2 miles, or, by connecting with the town road from the harbor front to the outer beach, about 3 miles. It is very convenient for the people of Provincetown and others who wish to go to and from the outer beach and life-saving stations, and has been extensively used by many summer visitors. It has remained in remarkably good condition for a sod road, considering the amount of travel which has passed over it. The first section of the road, built in the spring of 1894, is still in good condition, and has required but little work and attention.

The same method of checking the drifting of the sands and of reclaiming the lands has been followed; namely, the transplanting of beach grass for a sand binder, and the planting of trees, shrubs and seeds of various kinds, principally pines and bayberry (*Myrica cerifera*).

The transplanting of beach grass began about the middle of May, and continued, as weather permitted, until June 5, when this work was suspended. It was resumed about the middle of September, and continued until November 20, the total area covered during the season being about 20 acres. Owing to the excellent results obtained from the use of bayberry on ground already covered, it was considered advisable to introduce this shrub simultaneously with the grass; and, although a smaller territory was covered, permanent results were obtained.

As in past seasons, a large number of young pines taken from the woods and bogs have been transplanted along the foot of the slopes, and pine seeds planted on the flat grounds between the ranges of sand dunes.

The weather conditions during the entire season have been very favorable, and, as a consequence, a very marked improvement in the work of the past and present seasons is observable, the grass-plants, trees and shrubs having made a vigorous growth.

Notwithstanding the fact that during the last two months there have been some very strong winds, yet the planted territory remains intact, and no movement of sand from these sections is observable.

About 170 acres of the exposed slopes have been covered since the spring of 1895. An additional area of about 115 acres should have immediate attention, and when this is covered, a comparatively small outlay only will be required to keep the same intact.

Respectfully submitted,

JAMES A. SMALL,
Superintendent of the Province Lands.

[D.]

[See page 111 of this report, *ante*.]

REPORT OF ENGINEER ON TAUNTON RIVER AND BOSTON HARBOR CANAL.

BOSTON, Jan. 20, 1902.

To the Board of Harbor and Land Commissioners, State House, Boston, Mass.

GENTLEMEN: — In accordance with your instructions, I have had surveys and estimates made as to the probable cost of constructing a ship canal from Narragansett Bay to Boston harbor through Taunton River and Weymouth Fore River, under chapter 104 of the Resolves of 1901: —

> *Resolved*, That the board of harbor and land commissioners is hereby directed to make or cause to be made surveys and estimates as to the probable cost of constructing a ship canal beginning at some convenient point on Narragansett bay and Taunton river, harbor or estuary thereof, and extending across the state of Massachusetts through the cities of Taunton and Brockton and the town of Weymouth to Boston harbor by way of Weymouth Fore river. For this purpose the board may employ an engineer or engineers and other assistants, and may expend a sum not exceeding ten thousand dollars. The board shall report to the general court not later than the fifteenth day of January in the year nineteen hundred and two. Whatever amount is expended by the board for the purpose authorized by this resolve shall, in the event of the granting of any charter or franchise for the construction of a canal between the points above specified, be repaid to the Commonwealth by the grantee or grantees of such charter or franchise. [*Approved June 13, 1901.*

The statute simply provides for the surveys and estimates for a ship canal, without in any way indicating the size of ships to be provided for; but it limits the location by providing that it shall pass through the cities of Taunton and Brockton and through the town of Weymouth.

The plan adopted for the investigation is as follows: First, to determine the general character and dimensions of the canal, and where it could probably be located. Then the field surveys were undertaken, under the general supervision of Mr. Henry B. Wood, with Mr. Eugene E. Pierce, Mr. A. D. Butterfield and Mr. L. H. Bateman in immediate charge of the different survey parties; and in the office Mr. John R. Burke, Mr. W. W. Marrs, Mr. T. W. Bailey and Mr. E. W. Hadcock were employed in the preparation of the plans and estimates, the field note books being sent to the office, and the plans prepared as soon as the books could be spared from the field work.

Mr. F. W. Dean, Mr. S. E. Tinkham, Mr. Henry D. Woods and Mr. E. L. Brown have made estimates and examinations as to pumping, machinery, bridges, mechanical lift locks, and the nature of the soil through which the canal is to be constructed.

Upon the completion of the field surveys, Mr. D. J. Howell, who had been engaged as assistant engineer on the surveys and in preparing the report of the United States Board of Engineers on deep water ways from the Great Lakes to the Atlantic coast, and as consulting engineer in charge of the surveys and estimates for a barge canal from the Great Lakes to the Hudson River, under the direction of Hon. Edward A. Bond, State engineer and surveyor of New York, was engaged to assist in the preparation of the plans and estimates. Mr. Howell brought to the work a great fund of information collected during his work on the New York investigations, and to this is due much of the completeness of this report; as, owing to the limited time after the completion of the field work, it would otherwise have been impossible, with the small appropriation available, to prepare the necessary plans and estimates,— and, as it is, much is lacking, owing to our inability, through lack of means, to make borings and do other work necessary to obtain a complete knowledge of the facts.

My first endeavor was to determine the size of the canal which was required, and at my request you addressed a letter to Mr. Parker C. Chandler, who had been prominent in advocating the passage of the resolve through the Legislature, asking him for any information he had bearing on the subject under investigation, and also as to the size of the canal desired by the petitioners. In his reply he stated that considerable information might be obtained from documents in the State Library, and referred to the report of the committee of the Legislature who explored a line for a canal over this route, and made a report on the same in February, 1808. He also stated that reports had been made by officers of the general government on the same subject; and a copy of a report made by the Board of Internal Improvement and transmitted to Congress by the Secretary of War on Feb. 16, 1825, on the proposed canal from Barnstable Bay to Buzzards Bay, and also on a general examination of the route from Narragansett Bay to Boston harbor, has been found. This report stated that a general and thorough survey of this route appeared to be wanting.

A copy of a portion of a plan made by the United States Topographical Engineers in 1833, from a detailed survey of the portion of the route from Boston harbor to Brockton, has also been found; but the report of the engineers on this survey we have not been able to find up to the present time, although search has been made for it in the State Library and at the office of the Chief of Engineers at the War Department at Washington.

In regard to the size of the canal, Mr. Chandler stated that it was the intention of the petitioners to have that matter left open, so that the commissioners would study the matter and decide as to the size of the canal which would be required by modern vessels. He also stated that the general government had comprehensive plans for a scheme of inland navigation stretching along the coast line from Boston harbor to Florida, and the line from Boston harbor to Narragansett Bay was one link in this scheme. He also called attention to the various forms of mechanical lifts which had been designed and in some cases put in successful operation to take the place of the ordinary canal lock; and also to the modern machinery which had been designed for the construction of canals, thereby greatly reducing their cost, and also stated that the project for this canal would be called to the attention of the next Congress. He promised at the same time to forward several books, documents and maps which would be of service, but he was unable to do so.

As his letter did not give information as to the size of the canal required, in seeking other sources of information as to this question, letters were addressed to the Secretary of the Navy and the Secretary of War, asking what plans the government had in relation to water ways along the Atlantic coast, and especially between Narragansett Bay and Boston harbor, and as to the size of any proposed water ways in this location, also for such opinions as might have been expressed by any of the officers of the Engineer Corps or of the Navy as to the dimensions which such a water way should have.

The Secretary of the Navy in replying simply stated the dimensions which had been adopted in 1884 for a projected canal from Barnstable Bay to Buzzards Bay, and the dimensions of the Kaiser Wilhelm Canal and the Suez Canal, stating that this was all the information on file in the department which it was deemed would be of value to us.

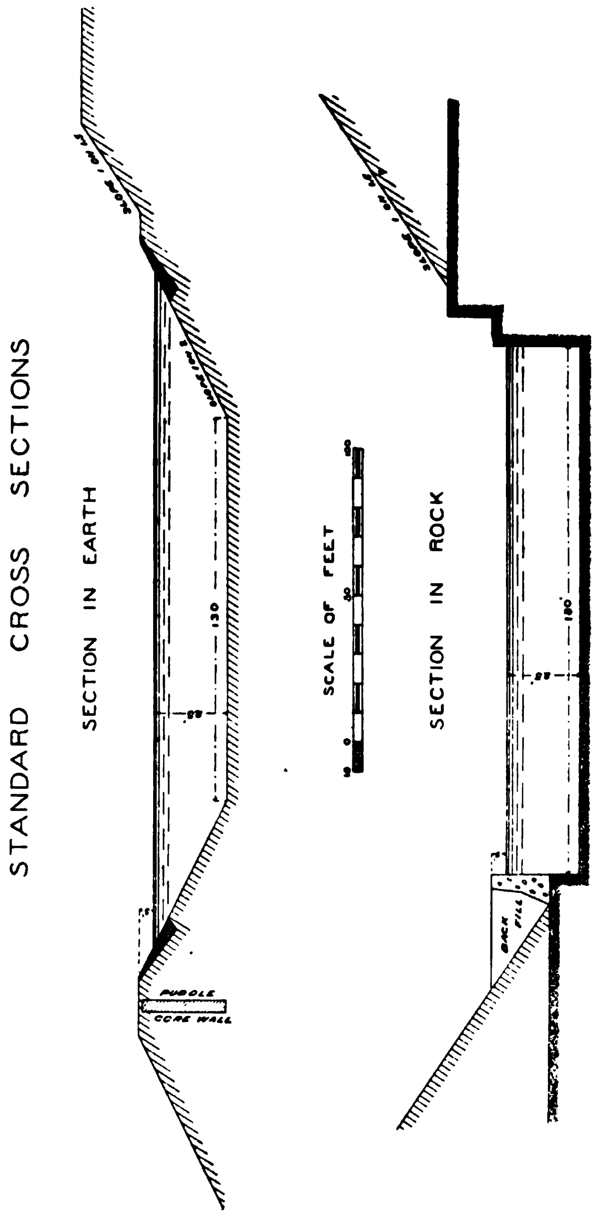
The letter to the Secretary of War was referred to the Chief of Engineers, and in his reply he stated that no plan had been formed by the federal government for a system of internal water ways along the coast from Maine to Florida, but that a number of inland routes are being improved, under appropriations made by Congress, between Delaware Bay and Florida, and that surveys for others within the same limits had been made, and forwarded copies of the latest reports on these works. On examination of these documents, it was found that all the water ways now under improvement are for light-draft vessels, and the only information as to such a ship canal as is proposed in the case under consideration was in a report made in 1894 on a survey for the Chesapeake and Delaware Canal, which was to connect Baltimore harbor with deep water at the mouth of the Delaware River. This was to be a canal 100 feet wide on the bottom and 26 feet deep at low water.

In view of the fact that the statute incorporating the Boston, Cape Cod & New York Canal Company, in 1899, fixed the dimensions of this canal as depth 25 feet and bottom width not less than 100 feet, it was decided that it would not be wise to adopt any smaller dimensions. A depth of 25 feet is sufficient to float the vessels engaged in the coastwise traffic, and, with the width of 60 feet in the locks, any of the naval vessels, except battle ships, could pass through.

In order that the canal shall have sufficient cross-section to enable vessels to pass through at a fair rate of speed, the width has been made 130 feet on the bottom, with the side slopes 1 on 2, for all sections where it is expected earth will be found; but where rock is encountered, the section will be 180 feet wide, with vertical sides. This gives cross-sections about four times greater than the midship section of the largest vessel which could safely navigate a canal of this depth, and is about the same as that of the Manchester Ship Canal. In this width the ordinary coastwise steamers could safely pass in any place with only a slight reduction in their normal speed through the canal.

Having fixed the dimensions of the trunk of the canal, search was made for an approximate location, using the plans of the State topographical map. A study was made on this map of the different lines which had been suggested at different times by various parties, among them the lines shown on the lithograph plan presented to the Legislature by Mr. Chandler, and the two lines surveyed by the United States Topographical Engineers between 1821 and 1833.

All the lines surveyed along this general location except the present scheme have been for small barge canals, and it was found that the general course followed by these would be the best for the proposed ship canal. In general, the line selected starts in Weymouth Fore River, a short distance above the bridge at Quincy Point; thence follows the valley of the river to Weymouth land-


STANDARD CROSS SECTIONS
SECTION IN EARTH
SLOPE 1 ON 1.5
130
28
PUDDLE
CORE WALL
SCALE OF FEET
10
0
50
100
SECTION IN ROCK
SLOPE 1 ON 1.5
130
28
BACK FILL

ing; thence up the valley of Smelt Brook a short distance, crossing the south shore branch of the Old Colony Railroad at Weymouth landing and the main street of the town close to the East Braintree boundary line; thence continuing up the brook and through the divide into the valley of the Monatiquot River; thence following up this valley, crossing the Plymouth & Whitman branch of the Old Colony Railroad and the present main line of the Old Colony Railroad just south of the South Braintree station; thence across Dyer hill, following along the Cochato meadows and crossing the Taunton branch railroad opposite Mayflower Park, and the line of the Cape Cod branch railroad about 3,000 feet north of Holbrook station; thence keeping a short distance east of the railroad and passing through the divide near Avon station into the valley of Trout Brook, and along the valley of this brook and Salisbury Plain River through the city of Brockton, crossing the Middleborough section of the Plymouth division of the New York, New Haven & Hartford Railroad a little south of Campello station; thence through the divide between the valley of the Salisbury Plain River and Town River, crossing the West Bridgewater branch of the Old Colony Railroad; thence along the valley of Town River, passing through Hockanock swamp, Nippinicket Pond, and the divide into the valley of the next stream south, a tributary of the Taunton River, which runs through the village of Raynham; thence down the valley of this stream and the Taunton River to Weir village in the city of Taunton, and thence following the Taunton River to its mouth in Mount Hope Bay.

The general location having been determined from the study of the maps, two parties were organized for making a detailed survey of the location. Base lines were run and the topography and hydrography surveyed the whole distance from Weymouth Fore River to Slade's Ferry bridge near the mouth of Taunton River. In general, the base line followed the line of the proposed canal, and the topography was surveyed for a distance of not less than 500 feet on either side of the line. The angles in the base line were connected with the triangulation stations of the town boundary survey, and in this way the whole work was checked and errors avoided. At a number of places where there appeared to be a choice as to the best location, the surveys extended over a considerably greater width.

Levels were run the whole length of the base lines, and on cross-sections every 500 feet; these levels furnished points from which the topographic parties could check their work. In addition, a line of precise levels was run from Somerset to Weymouth landing, following the line of the railroad and highways, connecting at frequent intervals with the line of levels run along the base lines. At the same time, tidal observations were made at both ends of the canal, and compared with the benches of the United States Coast Survey. From these levels, adopting the mean sea level calculated from the observations of the Coast Survey at Boston, it was found that the plane of reference of the survey was 1.5 feet below mean sea level at Boston, while the mean water level at Somerset was a few tenths of a foot higher than that at Boston, due probably to its distance up the river from the sea.

The difference in elevation of the various benches, as determined by the line of precise levels and the line run over the base line, did not vary at any point more than .3 of a foot. Many bench marks were established along the line of these levels, which will probably be found useful in future work. The results of these surveys have been plotted on a series of 24 sheets, each 30 by 52 inches, on a scale of 1 to 2,000, and one sheet about the same size on the scale of 1 to 5,000. On the large scale sheets contours were drawn showing every 2 feet difference of elevation, and on the sheets thus prepared the centre line of the proposed canal was located.

A diligent inquiry was made for information as to borings which had been made for any purpose along the line of the proposed canal, and as to the character of the material through which the wells in the vicinity had been dug or driven, also the same information in relation to other excavations. The outcrop of all ledges along the line of the survey were located by the survey parties, so that, although unable to make any borings of our own, sufficient information was obtained to give a very fair idea of the character of material to be excavated, and on what material the various structures would probably be founded.

Information furnished by the city engineers of Brockton and Taunton and by Mr. Edward Parrish of the United States Engineer Office at Newport was of much value in this part of the investigation, and other parts of the work were very much facilitated by using the plans and data furnished by them and others.

South of Brockton, in addition to the route finally adopted, surveys were made over a route crossing the divide to the west of Campello station, and following down the valley of Black Betty and West Meadow brooks, rejoining the original route at Skimmilk bridge, a short distance north of Nippinicket Pond. This route would have avoided the necessity of going directly through the village of West Bridgewater, but after considering the two, the easterly one was adopted as preferable. At the northern end an alternative route from South Braintree to the Weymouth Fore River was to follow the valley of the Monatiquot River from South

Braintree to Braintree; thence across the country to a point in Weymouth Fore River just south of the new works of the Fore River Ship and Engine Company. On the maps this appeared to be quite feasible, but, as it did not enter the town of Weymouth, as is required by the statute, it was not surveyed.

South of Taunton the line follows the general location of the Taunton River; but, owing to the sharp curves in the river, it was found necessary to cut through the bends in many places in order to get such an alignment as would enable large steamers and barges to safely navigate the new channel. It is planned to establish tidal locks at each end, the one in the Taunton River to be located just north of the village of Dighton, and the one at Weymouth Fore River on the westerly bank of the river, about opposite the northerly end of White's Neck. Between the tidal locks are 12 other locks, with lifts varying from 16 to 25 feet.

Alignment.

The total length of canal on which the estimates are based between the ends of the approach structures of the tidal locks is 31.79 miles; of this, 22.33 miles is straight, and the balance, 9.46 miles, on curves of radii varying from 2,000 to 10,000 feet, only 2.22 miles having radii of less than 5,000 feet.

On all curves of less than 10,000 feet radii the width of the canal was increased by an amount determined by the following formula: $60 - .005 \times \text{radius}$, all dimensions in feet, the additional width being added one-half on each side at the middle of the curve, and tapered to nothing at the tangent points.

The canal line was located where, from all the information obtained, it appeared that the canal could be most economically constructed within the limits prescribed by the resolve. Further investigations and borings to determine the character of the material through which it is to be built and on which the various structures are to be founded will undoubtedly show the advisability of some changes in the location of the canal and its various structures; but any changes which are liable to be made will not, in all probability, materially alter the total cost.

Northern Approach.

At the northern end of the canal deep water is found at the mouth of Weymouth Fore River, about 2½ miles below the bridge at Quincy Point. This channel is the approach to the works of the Fore River Ship and Engine Company; and in making the estimates it has been assumed that it would be enlarged and deepened by the general government as an approach to these works, and the cost of doing this work has not been included in the estimates for the canal.

Between the bridge and the tidal lock (a distance of about 1 mile) the estimates are for a channel substantially 500 feet wide and 25 feet deep at mean low water, the width being much greater than at any other portion of the canal, owing to the very sharp curves which it is necessary to introduce.

The most natural location for the purposes of navigation would have been to excavate a channel across the neck of land known as Old Spain, which would have given practically a straight channel from the mouth of the canal into the lower part of Weymouth Fore River. No estimates have been made for this, as it did not seem that the increased facilities for navigation would be sufficient to justify the greatly increased cost.

The plans of the general government for the improvement of the Weymouth Fore River are simply to obtain a channel from a point about opposite the proposed entrance lock of the canal up to the head of navigation, not less than 6 feet deep at mean low water, and of a width varying from 100 feet to 50 feet. This has been substantially completed, and no plans have been adopted for any further improvement.

Southern Approach.

At the southern end of the canal deep water is found in Mount Hope Bay just below the point where the line between Massachusetts and Rhode Island crosses it. Above this in Fall River harbor and between Fall River and Somerset there are long sections where the channel is more than 25 feet deep for a width of not less than 300 feet, but there are bars crossing it at a number of places. The plans of the general government contemplate the excavation of a channel 25 feet deep at mean low water and 300 feet wide through these bars up through Fall River harbor to Slade's Ferry bridge. From this point nearly up to Somerset, a distance of 3 miles, the channel is continuous, and of sufficient width and depth; from thence up to the entrance lock, a distance of 4.5 miles, the channel will have to be excavated to a depth of 25 feet at mean low water with a width of 300 feet. The plans of the general government at present contemplate the deepening and widening of the channel so as to secure a depth of at least 12 feet at high water, with a width of 100 feet up to Berkley bridge; thence the same depth and 80 feet wide up to Briggs shoal; thence 11 feet in depth with the same width up to the ship yard; thence 11 feet depth with a width of 60 feet up to Weir bridge at Taunton. These plans have been practically completed. The work remaining to be done consists of the removal of a small amount of ledge and some dredging below Berkley bridge. In making the estimates it has been assumed that the general government will carry out its plans and excavate the channel up to Slade's Ferry bridge, and the estimates include only the work of dredging the channel from the deep water below Somerset to the tidal lock.

Style of Lock.

In a canal of this size the question of the water supply is a very serious one, especially in a flat country, where the drainage areas tributary to the canal, especially those above the elevation of the summit level, are not large.

The ordinary form of lock to accommodate vessels of the size which may be expected to use a canal in this location requires the discharge of a very large volume of water from the upper level into the lower level whenever a vessel passes from one to the other. This loss from the upper level must be supplied from some source. In order to avoid the necessity for such a great loss of water, various mechanical devices have been designed. Many of these have been used on barge canals, but I know of no case where they have been used on a canal as large as the one now under consideration. In addition to the saving of water, these mechanical appliances are designed to be used for much higher lifts than the ordinary lock, so that each one will take the place of a number of the ordinary type, with a corresponding decrease in the length of time required for a vessel to pass from one level to another.

These mechanical appliances are of different types. The earliest, known as chain lifts, consisted of a wooden or metal box with gates at each end, filled with water, and large enough to contain the largest boat using the canal. To this were attached a number of chains which passed up over pulleys mounted on framework, the other ends of the chains being connected with counterweights sufficient to counterbalance the weight of the box full of water. After the boat was placed in the lock and the gates closed, sufficient water was either drawn into or from the box to make it heavier or lighter than the counterweight, so that it would either drop or rise, as required, to the other level of the canal.

Next come the various kinds of hydraulic lifts. These also consist of boxes or tanks sufficient in size to contain enough water to float vessels using the canal, and they are raised or lowered by hydraulic rams, which are either placed directly under the box or alongside it; in the latter case, the ends of the rams carry large pulleys over which pass chains or wire ropes, one end of which is attached to the press of the ram, the other to the side of the lock. These are ordinarily constructed in pairs.

The third form is the floating lift, which consists of one or more tight tanks floating in a deep pit, and supporting above them on trestle work the box of the lock. The floats being submerged, it requires the application of a small amount of power to raise or lower the lock.

The fourth form is the pneumatic lock, which consists of an inverted tank in a pit filled with water. On the top of this tank is the ordinary lock box, with gates at the ends, filled with water. These locks are designed to be used in pairs, the two inverted tanks being connected by large pipes, and the air passing from one to the other as the locks are raised and lowered, one rising as the other lowers.

The first three styles have been used in various forms in this and European countries, but so far as I have been able to learn, the pneumatic lifts have not been in use as yet.

Mr. Woods's notes, describing the various lifts which have been designed or built, are hereto annexed.* From the results of this study, and as the heights of the lifts in the canal under consideration are well within the range of work which has already been constructed, and as the construction of mechanical lifts of this size would be somewhat of an experiment, none having actually been constructed, it has been decided that for the purpose of this estimate it will be better to provide for using the ordinary style of lock.

Water Supply.

Having decided to base the estimates on the ordinary style of lock, the question arises as to where the necessary water supply can be obtained.

The number of vessels arriving at Boston from southern ports in 1900, as stated in the annual report of the Boston Chamber of Commerce, is as follows: tugs, 1,235; steamers, 1,083; barges, 2,817; total, 5,135, — an average of about 14 per day. If these all came and returned through the canal and passed through the locks singly, it would make 28 lockages per day; but, as the arrivals are not regular, and the locks being large a number can pass through at one lockage, it has been deemed best to assume 20 lockages per day of the full-sized locks as a basis on which to calculate the supply of water required. All of the locks north of the summit level of the canal except the tidal lock have lifts of practically 25 feet each. The locks south of the summit level vary from 16 feet to 21 feet lift, and, on the basis of 20 lockages each day, it will require 30,000,000 cubic feet of water daily to operate the locks.

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* Not printed.

As the canal is located so as to be generally below the groundwater level of the surrounding country, the loss of water from seepage would probably not be large. To provide for this and for the leakage through the lock gates and culverts, it is estimated that 3,000,000 cubic feet per day will be required, making the total amount of water required 33,000,000 cubic feet per day.

There is no drainage area near the location of the canal which will supply such a large quantity of water at an elevation above the summit level, and such small portions as are at the necessary elevation are largely used at the present time in supplying the population in their vicinity with water for domestic use. The stream which most nearly meets the required conditions is the Blackstone River. This has a drainage area above the dam at Millville in Blackstone of 258 square miles; and, if all the water from this drainage area can be intercepted and stored, it would nearly supply the demands of the canal, on the basis of 20 lockages per day of the full-sized locks. The river at Millville is about 70 feet above the summit level of the canal, — a sufficient elevation to enable the water to be diverted into it.

An aqueduct capable of conducting the water would be about 30 miles long, and would have to be built very largely in tunnel. It would be very nearly straight, and would pass along the southerly side and near the summit of the main divide, separating the streams which flow northerly into Boston Bay and southerly into Narragansett Bay, crossing nearly all the valleys which it intersects substantially at right angles.

Owing to the configuration of the country, it would be difficult and expensive to construct reservoirs to store all the water on this water-shed. For this reason, another method of furnishing the water supply was investigated, viz., to pump it from the Weymouth Fore River at the northern end of the canal up into the summit level. For this purpose four sets of pumps would be required: one set to pump from the river directly into the level above lock No. 3; another set to pump from the level below lock No. 4 into the level above the same lock; the third to pump the water from the level below lock No. 5 to the level above the same lock; and the fourth to pump from the level below lock No. 6 into the summit level.

Owing to the large quantity of water to be raised, the estimates have been made for furnishing a steam plant at each pumping station, as being cheaper and more reliable than generating the power at one station and distributing it by electricity. The first cost of the pumping plant is very small compared with the cost of furnishing the water from the Blackstone River, but the operating expenses are very large. Upon comparing the two estimates on the basis of capitalizing the operating expenses of both systems, the pumping system was found to be the least expensive. Moreover, the pumping system would be more compact, and there would be much less disturbance of local conditions.

One serious objection to the use of the water from the Blackstone River is its polluted condition, it being, according to the reports of the State Board of Health, the most seriously polluted stream in the Commonwealth.

Locks.

The highest point on the line of the canal is about 160 feet above mean sea level, and is located just north of the city of Brockton, in Holbrook and Avon; and the water surface of the summit level of the canal has been fixed at elevation 130. The ascent from Weymouth Fore River to the summit is quite regular, and much steeper than the descent to Taunton River.

The estimate provides for 5 locks, each of 25 feet lift, in addition to the tidal locks, to reach the summit level from Weymouth Fore River. The first 2 of these, located at Weymouth landing, are arranged as tandem locks, and are built double. The other 3 locks are built single, and are located on one side of the centre line, so that a companion lock can be built in the future without disturbing the existing one.

Between the summit level and the tidal lock in the Taunton River the estimates provide for 7 locks, with lifts varying from 21 to 16 feet; they are all single locks, arranged the same as the single locks between the summit level and Weymouth Fore River.

The locks are all planned to be 60 feet wide and 550 feet long between the hollow quoins, this length being divided into two chambers, respectively 350 feet and 200 feet, by a set of middle gates. The total length of the lock structure over all is about 730 feet, and the depth on the sill 25 feet. The gates are planned to be of steel, and of the standard mitre form.

In addition to the operating gates, the estimates include guard gates at both ends of all the single locks, and at the foot and head of the combined locks at Weymouth landing; so that, in case of accident, by closing the guard gates the lock may be pumped out and repairs made without interfering with the other portions of the canal.

The estimates for the locks, as well as for the other structures in the canal, are principally based on the designs and estimates made by the United States Board of Engineers on deep water ways, and on those of the State engineer and surveyor of New York for a 1,000 ton barge canal from Lake Erie to tide water.

Lock Approaches.

The estimates provide for the construction at both ends of each lock of vertical walls either of concrete or timber cribs, to guide vessels into the lock and allow for their being tied up awaiting the opening of the gates. These are planned so that, in case an additional lock is built later alongside of the existing one, as small a portion as possible of the existing structures will have to be torn out and rebuilt.

By-passes. — Waste Weirs.

The estimates also include the cost of the necessary structures to maintain the level of the water in the canal by discharging any surplus over spillways or waste weirs either into adjacent streams or artificial channels, which will take the water around the various locks into the level below, or waste it into existing streams. These are designed to care for the largest freshet which is likely to occur on the water-shed. It will probably be necessary to enlarge the standard section of the canal in a few places, to enable it to pass the flood discharges; but the time has not been sufficient to go into this matter fully, but, in any event, it will not be a large additional expense.

Estimates have been made for two masonry dams at the two ends of the canal across the Taunton and Weymouth Fore rivers opposite the tidal locks, to impound and maintain at about high-tide level the water in the rivers and tide-level sections of the canal. These, as in the case of the waste weirs of the canal, have been designed to take care of the flood discharges without unduly raising the water level either in the canal or rivers.

Stream Crossings.

As the canal generally follows the thread of the streams flowing through the valleys in which it is located, it receives the natural drainage from the water-shed; and, as the water supply of the canal is to be supplied by pumping water from the Weymouth Fore River, the drainage into the lower levels will be discharged through the waste weirs into the streams where they diverge from the line of the canal; and the Town River, which crosses the line of the canal at West Bridgewater, is to be conducted through a culvert under the canal, so that the water supply to the streams below will not be interfered with. The mills and dams on the streams at South Braintree and Raynham, lying, as they do, directly in the line of the canal, are necessarily destroyed.

Diversion of Railroads and Highways.

In planning for the construction of work of this magnitude, it is impossible to avoid interfering with many existing structures. The proposed line of the canal crosses the various lines of the New York, New Haven and Hartford Railroad at eight places, in addition to the existing drawbridges at Somerset and Slade's Ferry, and the freight yard at Brockton. At four of these places the crossing cannot be avoided, and estimates have been made for drawbridges. At the others, estimates have been made for diverting the railroads so as to avoid their crossing the canal.

Forty-six highways now cross the line of the canal. Estimates have been made for 14 drawbridges, and for rearranging the highways and diverting some of them. The plans have been so arranged that the distance to be travelled in most cases will not be materially increased over the distance between the same points by the existing routes.

The railroad bridges are all planned for two tracks, except the one at Campello, which is planned for four. The highway bridges, are planned to carry an electric railway, to have a roadway 34 feet wide, and two sidewalks, the whole to be 50 feet wide over all.

In all cases the clear width for the passage of vessels is to be 100 feet, except in the four-track bridge, and where the bridges are located at the ends of locks; in these cases the clear passageway is to be 60 feet, the same as the width of the locks.

Owing to the sharp angles at which the railroads cross the canal in some places, and at others to the curves in the railroads, it was found necessary to plan slight deviations in the locations of all the railroads but one, in order that they might cross the bridges on tangents, and more nearly at right angles to the line of the canal. The estimates include the cost of a new railroad bridge across the Taunton River at Somerset, as the draw in the present bridge is not adapted for the convenient passage of large vessels.

Protection of the Walls and Banks of the Canal.

Wherever the water level of the canal will be above the present surface of the adjacent country, the embankments on the sides are planned to have puddle walls of clay built through their centres; and wherever the banks of the canal throughout its length consist of earth, the estimates provide for protecting them with a coating of broken stone, extending from 5 feet below the water level of the canal to 5 feet above that level, as shown on the standard cross-section, in order that they may not be injured by waves created by passing vessels.

Turning Basins.

In order to enable vessels to enter the canal from either end with cargo for any of the cities or towns on the line of the canal, turning basins or harbors have been provided at Taunton, Brockton and Holbrook, approximately 600 feet square, where vessels may be turned around so that they may return.

In addition to these harbors, wharf walls, to be located at various points along the canal, are included in the estimates.

Electric Power and Lights.

The estimates include the cost of an electric power and lighting plant, to be located and operated with one of the pumping stations and the necessary wire lines, lamps and motors, to operate the drawbridges, lock gates and sluices and to light the canal throughout its length.

Right of Way.

The cost of sufficient right of way to enable the canal to be constructed without trespassing on other property has been included. The area required is based on the amount of territory required to deposit the material excavated from the canal alongside of the place from which it is excavated, without piling it higher than 10 feet above the surface, and not allowing it to come within 25 feet of the bank of the canal at any point. This general plan has been modified in its application, so that through cities and improved territory a comparatively narrow strip should be taken, generally little more than sufficient for the operation of the canal; and where the land was of less value, larger areas are included, in order to allow room for the deposit of material taken from the narrower sections.

Unit Prices.

The unit prices used in determining the value of the work to be done in the construction of the canal are based very largely on those adopted by the United States Board of Engineers on deep water ways, and those used by the State engineer and surveyor of New York in making his estimates for the 1,000 ton barge canal through New York. These have been compared with the prices paid for work on the metropolitan water system and other works in the vicinity of Boston, and modified as found necessary.

The larger part of the masonry has been estimated as concrete, stone to be used only where the masonry will be subject to wear.

Estimates.

Owing to the short time which was available for making up the estimates, and to the uncertainty as to the exact character of the material through which the canal is to be constructed, it has been impossible to make the estimates with the exactness which would have been done if time and means had allowed; and for this reason it has been deemed best to add 15 per cent. to the figures, to cover possible contingencies and unknown quantities, as well as the usual expenses attending any such undertaking. The estimates are as follows: —

Excavation, including approaches between Quincy Point bridge and Slade's Ferry bridge,	$20,103,662
Backfill,	908,080
Culverts and by-passes,	980,000
Retaining walls,	1,494,660
Puddle walls,	144,317
Wash walls,	1,196,072
Spillway and waste weirs,	815,000
Stop gates,	300,000
Highway changes,	343,100
Railroad changes,	462,000
Highway bridges,	1,633,000
Railroad bridges,	1,380,000
Dams,	170,000
Locks,	12,233,000
Lock approaches,	2,406,620
Power and lighting plant,	220,000
Water supply plant,	2,532,499
Maintenance plant,	200,000
Right of way and damages,	2,580,910
Engineering and contingencies, 15 per cent.,	7,515,438
Total,	$57,618,358

The work of preparing the report and estimates has been pushed with all practicable speed, and every effort has been made to have the estimates as complete and accurate as possible with the information available; in order to do this, plans have been used before they were inked in and completed. The office force is still at work on them, but it will be some time before they are completed, and, with the field notes, put in proper shape to record and file away.

Two plans, one showing the location and the other the profile of the proposed canal line, are forwarded herewith, together with a diagram showing the standard cross-sections on which the estimates are based.

Respectfully,

FRANK W. HODGDON,
Engineer.

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TENTH ANNUAL REPORT

OF

THE COMMISSIONERS

OF THE

MASSACHUSETTS NAUTICAL TRAINING SCHOOL.

JANUARY 1, 1902.

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Commonwealth of Massachusetts.

MASSACHUSETTS NAUTICAL TRAINING SCHOOL.

To the Honorable the Senate and House of Representatives of the Commonwealth of Massachusetts in General Court assembled.

The Commissioners of the Massachusetts Nautical Training School have the honor to submit their report of the operations of the school for the year 1901.

The Work of the Year.

During the year ending Dec. 31, 1901, the work of the Nautical Training School has progressed in a satisfactory manner. The number of cadets has been fully up to the average standard of the school, and the class of students received has been somewhat higher than heretofore.

During the winter months the "Enterprise" was moored at the wharf of the North End Park, where the regular routine work of the school was pursued, which included, in addition to theoretical studies, practical instruction in mechanics and engineering, as well as in seamanship and navigation.

Repairs.

Needed renewals to the outfit of the "Enterprise" were made during the spring, which included sails, study tables, blackboards, benches, an engine lathe and Crosby indicator, etc., the expense amounting in all to about $2,800. A new gun-deck will be required for the ship within a year, and other repairs, at an estimated outlay of $2,500.

THE SUMMER CRUISE.

Early in May the "Enterprise" was cleared of her winter deck-house, her sails were bent, rigging overhauled, and the ship was fitted for sea. This work was all done by the cadets, aided by the crew.

On May 16 the commissioners visited the "Enterprise" and carefully inspected the ship and the cadets, finding everything in excellent condition.

On May 18 the "Enterprise" left the wharf and anchored in the harbor, and, after taking stores on board, she sailed on June 1 on her summer cruise.

In preparing the itinerary for the summer cruise of the "Enterprise" for 1901, the commissioners departed from the usual custom and arranged to send the ship into the North Sea and the Baltic, touching in turn at Leith, Scotland; Copenhagen, Denmark; Cronstadt, Russia; Antwerp, Belgium; Gravesend, England; Gibraltar; and Funchal, Madeira. This cruise was estimated to be four months in duration.

The following extracts from the interesting report of Commander Edward M. Hughes, U. S. Navy, will give a clear idea of the summer cruise of the "Enterprise:" —

Leaving Boston about 5 P.M. on Saturday, June 1, the ship proceeded to sea, bound for Leith, via the north and east coasts of Scotland. The passage was made in about twenty-five days and sixteen hours, actual time, the anchor having been dropped in Leith Roads at 6.38 o'clock on the morning of the 28th of June. The track, rather devious for the first fortnight, was to the eastward until longitude 49 degrees was reached, when a general north-easterly course and good runs were made, the ship passing between the Shetland and Orkney islands.

Much fog was encountered until clear of the Newfoundland banks, and again in the vicinity of the Shetlands. The only land seen until we were to the eastward of the Orkneys was Fair Isle, our intended landfall. Indeed, on account of possible currents and the fog, I at one time had just changed the course to pass entirely around the Shetlands, when a fortunate observation was obtained from which a course could be shaped to go between the two groups of islands. Over half the passage was occupied in getting to the eastward of longitude 45 degrees. This was due to light breezes and some easterly winds. Steam was used for two days after leaving Boston, for nine hours on June 13, and for the last two days of the passage, the ship reaching Leith with forty tons of coal in the bunkers, having consumed eighty tons for all purposes en route.

A feature of the passage was the length of days after getting well to the northward, and it looked odd to see the cadets of the "watch on deck" curled up on the lee side of the quarter-deck, under their tarpaulin, in broad daylight, standing by for a call which no doubt would have found most of them "all abroad."

The day after arriving in Leith Roads the vessel moved into one of the docks, the use of which was given free on account of our character as a public vessel. We were given a very good berth in the Edinburgh dock, which is the one farthest from the entrance. Leith Roadstead is very uncomfortable, with easterly winds, and it would have been impracticable for this ship to have lain there and given the boys liberty or gotten them back to the ship with any certainty as to time. In Leith each watch of cadets was given forty-eight hours' liberty. The conduct of the cadets was very good, and they have shown a very commendable spirit of willingness and good temper, which leaves little to be desired. On the cruise we were fortunate in having smooth seas for the first ten days or so, enabling the boys to get fairly on their sea-legs before meeting bad weather.

We left Leith docks at 1 P.M. on July 4, ship dressed with ensigns at each mast-head, and after hoisting our boats outside, proceeded at once for the port of Copenhagen. Our flags were kept flying until the fog shut in the town.

On the passage to Copenhagen, on the afternoon of July 8, we passed the German kaiser's yacht "Hohenzollern," flying the imperial standard, bound to the northward. The "Hohenzollern" was accompanied by a corvette of the "Irene" class. When just past us, the imperial yacht dipped her ensign to us, which unexpected courtesy was promptly returned. Very early on the morning of the same day, July 8, we passed three German torpedo boat destroyers, also bound north.

In Copenhagen we found the United States training ship "Hartford" moored to the buoy next to the one assigned us. She had been in port for a week or ten days. She left for Stockholm on July 13, a few hours before our departure for Petersburg. During our stay in Copenhagen the weather was exceedingly fine, though somewhat warm. While in the Danish capital I made the usual official calls upon the United States chargé d'affaires, Danish minister of marine, admiral, commandant of the dock yard, captain of the station ship, captain of the port, and the prince regent.

We left Copenhagen at noon on July 13, and reached St. Petersburg at 5 P.M. on July 18. On the 18th we were detained at anchor in Cronstadt from 7.30 A.M. until 2 P.M., awaiting permission to proceed and an assurance that a berth had been reserved for us in the narrow waters of the Neva at St. Petersburg. The weather experienced in the Baltic and the Gulf of Finland was very fine. The winds, however, or the lack of them, permitted but little sailing to be done. In the Baltic calms and light northerly airs were found (except for a few hours of the 14th and 15th), and in the Gulf were encountered light easterly winds. The vessel was under steam throughout, save from 5 A.M. of July 14 to noon of July 15, when she was under sail alone. A pilot was taken, both in and out, between Cronstadt Roads and Cronstadt, and Cronstadt and St. Petersburg. The Russian admiralty office furnished a tug to help moor us. We were given an excellent berth close up to the Nicholas bridge, near the centre of the city, mooring head and stern to buoys, and with one anchor down.

On the afternoon of July 19 the German training ship "Charlotte" came up and moored just below us. She carried a crew of about five hundred men and fifty naval cadets. Prince Adelbert, the third son of the German kaiser, who is a cadet on board, paid a short visit to the czar at Peterhoff on Sunday afternoon, July 21, and on the 23d instant the czar visited the German ship, in honor of which event both the "Charlotte" and the "Enterprise" full-dressed ship with flags, rainbow-fashion, and manned yards and rail respectively.

While lying in Cronstadt, I was boarded by officers representing the following: Vice Admiral Messer (acting governor of Cronstadt), Rear Admiral Kasherininoff (president of trial board), and the commanding officers of the imperial yacht "Polar Star" and the Grand Duke Alexis' yacht, respectively. I made calls on these officers, receiving in turn calls from the commanders of the yachts. The governor was absent, and Admiral Kasherininoff was on the point of leaving Cronstadt on duty. I also called on our consular representative at Cronstadt.

From Copenhagen I instituted inquiries regarding the tolls for passing through the Kiel ship canal. I received answers to my letters while in St. Petersburg, and was so impressed with the saving, both in time and money, that would result in leaving the Baltic via the canal, that I arranged to go to Holtenau (near Kiel) with that end in view. The time required to pass from the Baltic to the Elbe is about eight hours. The distance saved is two hundred and fifty miles, all of which would doubtless have to be made under steam.

We left St. Petersburg on July 25, with about one hundred tons of coal on board, and Holtenau, the Baltic entrance to the Kaiser Wilhelm ship canal, was reached at 11 P.M. on July 29. As we approached Holtenau, we passed several squadrons of torpedo boats and destroyers engaged in manœuvring, night signalling, etc. In Kiel harbor, distant some two or three miles from our anchorage, were the German men-of-war "Moltke" and "Stoch." Official calls were exchanged with the commanding officers of these vessels, and I also called upon Admiral Von Kohster, commanding the station, and upon the captain of the port. Commander W. H. Beehler, U. S. N., our naval attaché at Berlin, came down to Kiel upon my arrival to call upon us and upon the U. S. S. "Hartford," which arrived from Stockholm on July 30.

We left Holtenau on the morning of July 31 for the North Sea, via Kaiser Wilhelm ship canal, entering the Holtenau lock at 5.35 A.M., and leaving the canal at Brunsbuttel at 4.15 on the afternoon of the same day, the passage consuming about ten hours, including several short stops en route. The expense incurred, pilotage, tolls, clearance, telegraphing, etc., was one hundred and seventeen dollars; but the passage via the canal effected a saving of two hundred and fifty miles of distance, which, with coal at six dollars per ton, made it seem economical to use it.

We arrived at Antwerp at 5.20 P.M. on August 2, mooring just abreast the cathedral near the centre of the city. A pilot was taken from the sea to Flushing and from Flushing to Antwerp, also between these points when outward bound. We left Antwerp at 10 A.M. on August 10, anchoring for an hour or two off Flushing to wait for the weather to declare itself. While waiting at this point the king and queen of England arrived in the royal yacht, escorted by two British cruisers, being on their way to attend the funeral of the late Empress Augusta of Germany. We half-masted our colors and dressed ship with mast-head flags, following the motions of the English vessels.

Crossing the English channel on the night of August 10, we picked up a Gravesend pilot off Margate on the following morning, and at 5.35 P.M. of August 11 moored to a buoy at Gravesend, thoughtfully reserved for us by Mr. Petherick of the U. S. Despatch Agency, London. The U. S. S. "Hartford" arrived at Gravesend from Kiel on the evening of August 15. While in Gravesend liberty was given freely, and those cadets who were provided with the means had opportunities to visit London. A theatrical entertainment was given the cadets in Gravesend through the kindness of the mayor and the manager of the theatre. While in Gravesend we were granted the privileges of the Thames Yacht Club, and were called upon by the army officers stationed in the vicinity, all of which was duly acknowledged. In London I called upon our ambassador, Mr. Choate, who received me very cordially.

We left Gravesend for Gibraltar on August 18. Pleasant weather was experienced in the bay of Biscay and on the passage, but light airs and moderate to light easterly winds prevailed, so that much steaming had to be done. We anchored off Gibraltar at 4.40 P.M. on August 29. For the last part of the passage the same conditions prevailed that we found a year ago, — calms and a long easterly swell after passing Cape St. Vincent, and a strong Levanter in the strait. On the morning of the 29th we passed the British Mediterranean squadron (twenty-five vessels in all, including torpedo boat destroyers), bound out to meet the channel squadron off St. Vincent, after which they were to engage in fleet manœuvres. The U. S. ships "Saratoga" and "Castine" were found in Gibraltar on our arrival there. The Pennsylvania schoolship "Saratoga" was to leave for Tangier a few days after us, and the "Castine" sailed for Philadelphia on Saturday, August 31. The usual calls were made and returned in Gibraltar.

We left Gibraltar for Madeira at 10.13 A.M. on September 1, and arrived at Funchal at 11.30 P.M. on September 6, after a passage during which nothing but light airs and head winds were encountered.

I think the cruise was made as economically as possible, considering the length, the number of ports visited, the fact that we have distilled all our drinking water, etc. Boat sailing has been practised in nearly every port.

We were all shocked to learn of the probably successful attempt to assassinate President McKinley, which news came a day or two after our arrival at Funchal.

The "Enterprise" arrived in Boston on October 12, in command of the executive officer, Lieut. Robert E. Coontz, U. S. Navy; and the commissioners were grieved to learn that the superintendent, Commander Edward M. Hughes, U. S. Navy, was very seriously ill.

On October 15 the "Enterprise" was moored at her old berth at the North End Park, by permission of the commissioners of the bath department, city of Boston. Commander Hughes was surveyed by a medical board, by order of the Navy Department, and granted three months' sick leave.

On November 4 he was removed from the "Enterprise" to the naval hospital at Chelsea, where he is now slowly but steadily improving in health.

Commander Hughes has been succeeded in the command of the "Enterprise" by Commander Conway H. Arnold, U. S. N., under orders from the Navy Department.

PERSONNEL.

The following officers are now attached to the ship: Commander Conway H. Arnold, U. S. N., commanding officer and superintendent; Lieut. George B. Bradshaw, U. S. N., executive officer and instructor in seamanship; Lieut. James F. Carter, U. S. N., navigator and instructor in navigation; Ensign Walter G. Richardson, U. S. N. (retired), instructor; Mr. Frank D. Terry, chief engineer and instructor in steam engineering and electricity; Dr. Junius C. Gregory, surgeon; Mr. John L. Berry, instructor; Mr. Alfred E. King, captain's clerk.

The changes in the officers and instructors of the school during the past year have been as follows: April 1, 1901, Lieut. Jas. F. Carter reported as navigator and instructor; May 7, Ensign W. G. Richardson reported as ensign and instructor; November 4, Commander E. M. Hughes was detached; November 8, Commander Conway H. Arnold reported for the command of the "Enterprise;" November 23, Lieut. Robert E. Coontz was detached; December 1, Lieut. George B. Bradshaw reported for duty as executive officer; December 1, Mr. Frank D. Terry was engaged as engineer and instructor, vice W. A. Colcord.

STATISTICS OF CADETS.

Cadets admitted during the Year 1901.

Number in the school Jan. 1, 1901: —			
Seamanship class,		39	
Engineer class,		62	
Total,			101
Applications received, 1901,		95	
Awaiting examination,	1		
Failing to appear for examination,	9		
Unsatisfactory recommendations,	1		
Applicants examined,	84		
	95		
Examined,		84	
Failed to pass mental examination,	42		
Passed examinations,	42		
	84		
Passed examinations,	42		
Re-examined mentally and passed,	28		
Readmitted,	1		
		71	
Total number admitted to school during 1901,			71
Total number connected with school during 1901,			172
Cadets withdrawn during the Year 1901.			
Total number regularly graduated,		29	
Seamanship class,	11		
Engineer class,	18		
	29		
Total number granted an honorable discharge,		20	
Seamanship class,	8		
Engineer class,	12		
	20		
Total number graduated and honorably discharged,		49	
Deserted,	2		
Dismissed,	2		
Dropped from roll,	12		
Total number dismissed, etc,		16	
Total withdrawals during 1901,			65
Number of cadets in the school Jan. 1, 1902: —			
Seamanship class,		46	
Engineer class,		61	
Total,			107

THE WINTER TERM.

The "Enterprise" is moored at the North End Park, Boston, where she will remain during the winter term.

Instruction is now being given on board to one hundred and eight cadets, which is about the total number that the ship will accommodate.

The commissioners and the superintendent would be gratified to have members of the Legislature visit the "Enterprise" at the above-mentioned wharf on any day excepting Saturday and Sunday, when the cadets are absent at their homes, to see for themselves what work is being accomplished in this school.

SUMMARY.

The following tables show the different capacities in which the cadets have been employed since leaving the school, and also the branches of service in which they have been engaged, so far as known by the commissioners: —

Seamanship Class.	
Masters,	4
First officers,	6
Second officers,	11
Third officers,	4
Fourth officers,	2
Chief quartermasters,	3
Quartermasters,	40
Junior quartermaster,	1
Cadets and seamen,	49
Boatswains,	4
Chief yeomen,	2
Third lieutenant, U. S. revenue cutter service,	1
Cadets, U S. revenue cutter service,	2
Cadets, U. S. Naval Academy,	2
Third deck officer, U. S. coast survey,	1
Fourth boat keeper, pilot boat service,	1
Engineer Class.	
Chief engineers,	3
First assistant engineers,	3
Second assistant engineers,	15
Third assistant engineers,	4
Engineers and assistant engineers,	16
Engineer cadets and oilers,	35
Firemen,	8
Machinists (afloat),	10
Machinists (on shore),	18
Warrant machinists in U. S. Navy,	2
Chief electrician,	1
Electricians,	26
Total,	274

Class of Vessels.

Pacific coast steamers,	8
Transatlantic steamers,	62
Coastwise steamers,	51
"Tramp" steamers and towboats,	17
Steam yachts,	13
Sailing vessels,	30
U. S. transports,	14
U. S. revenue cutter steamers,	8
U. S. coast survey steamers,	6
U. S. light-house service,	2
U. S. naval vessels,	29
Total,	240

MEMBERSHIP OF THE SCHOOL — GRADUATES FOR 1901.

Spring Graduating Class, April, 1901.

Bolton, W. R.,	Engineer	Cadet,	Cambridge.
Coholan, J. J.,	Seaman	"	South Boston.
Holden, M. H. L.,	Engineer	"	Worcester.
Harrington, C. D.,	Seaman	"	Cambridge.
McDonald, R. S.,	Engineer	"	Boston.
Marshall, A. R.,	Seaman	"	North Easton.
Murphy, E. I. K.,	Engineer	"	Worcester.
Parsons, F. E.,	Seaman	"	Kendall Green.
Patterson, R. A.,	Engineer	"	Brighton.
Richardson, G. W. W.,	"	"	Melrose.
Salles, A. W.,	Seaman	"	Dorchester.
Warren, D. W.,	Engineer	"	Revere.

Autumn Graduating Class, October, 1901.

Anderson, W. A.,	Seaman	Cadet,	Gloucester.
Browne, F. A.,	Engineer	"	Westborough
Boyle, P. T.,	"	"	Worcester.
Bruce, G. H.,	"	"	East Gloucester.
Bicknell, T. H.,	Seaman	"	Melrose.
Crandall, C. H.,	"	"	North Attleborough.
Driesner, G. F.,	Engineer	"	North Attleborough.
Foss, J. W.,	"	"	Amesbury.
Goffin, E. W.,	"	"	Wood's Hole.
Heintzeman, C. H.,	Seaman	"	Brookline.
Kroh, H. A.,	Engineer	"	Roxbury.
Lea, J. B.,	"	"	Methuen.
Maglathlin, S. A.,	"	"	North Easton.
Mason, D. C.,	"	"	Everett.
Sackett, E. E.,	"	"	Lynn.
Tucker, R. W.,	Seaman	"	Kendall Green.
Went, T. B.,	"	"	Brookline.

Class to Graduate April, 1902.

Butler, D. F.,	Engineer Cadet,	North Easton.
Boesch, H. E.,	Seaman "	Wakefield.
Castle, A. E.,	Engineer "	Methuen.
Castle, George,	Seaman "	Lynn.
Cook, S.,	Engineer "	Nantucket.
Connor, W. H.,	" "	Boston.
Campbell, E. J.,	" "	Boston.
Chisholm, W. M.,	Seaman "	North Attleborough.
Connors, M. L.,	Engineer "	Dorchester.
Hynes, J. J.,	" "	Holyoke.
Hathaway, B. W.,	" "	Taunton.
Jensen, A.,	Seaman "	Provincetown.
Kenny, W. J.,	Engineer "	Malden.
Luby, J. E.,	" "	New Bedford.
Lamb, G. C.,	Seaman "	North Attleborough.
McGuire, G. E.,	Engineer "	Halifax.
McKay, O. E.,	Seaman "	Provincetown.
Murphy, J. F.,	Engineer "	Worcester.
McCrillis, H. W.,	" "	Malden.
Mort, F.,	" "	North Adams.
Ruggles, L. G.,	" "	Neponset.
Russey, R. B.,	" "	Cambridge.
Soule, B. F.,	Seaman "	Lynn.
Saunders, E. L.,	Engineer "	Brockton.
Wood, H. J.,	" "	Lawrence.

Class to Graduate October, 1902.

Archie, A. P.,	Engineer Cadet,	Gloucester.
Aechtler, F. W.,	Seaman "	Brookline.
Butterfield, F. J.,	" "	Haverhill.
Chase, A. F.,	" "	West Harwich.
Crockett, G. E.,	Engineer "	Malden.
Cushing, A. R.,	Seaman "	Dorchester.
Grandin, H. V.,	" "	Boston.
Hart, A. W.,	Engineer "	North Truro.
Jones, L. R. F.,	" "	South Hingham.
Lithgow, T.,	Seaman "	Boston.
Luscomb, B. R.,	" "	Nahant.
Luther, A. T.,	" "	Swansea.
Marshall, J. H.,	Engineer "	Gloucester.
Madden, E. J.,	Seaman "	Everett.
O'Reilly, W. I.,	" "	South Boston.
Parker, H. T.,	" "	Rockport.
Peterson, R. L,	Engineer "	Plymouth.
Rydquist, C. H. A.,	Seaman "	Brockton.
Reidy, J. A.,	Engineer "	Boston.
Spaulding, A. B.,	" "	Peabody.

Seibert, F. C.,	Seaman	Cadet,	Greenfield.
Trefethen, H. E.,	Engineer	"	Merrimac.
White, R. S.,	"	"	Malden.
Whalen, M. J.,	"	"	Peabody.

Class to Graduate April, 1903.

Bostwick, H. M.,	Seaman	Cadet,	Northbridge.
Baylies, E. W.,	"	"	New Bedford.
Clapp, L. A.,	"	"	Brockton.
Christiernin, A. F.,	"	"	East Boston.
Chase, A. B., Jr.,	"	"	New Bedford.
Chandler, F. C.,	"	"	Brookline.
Collins, J. H.,	"	"	Lawrence.
Farnham, C. B.,	"	"	Malden.
Goodspeed, R. W.,	"	"	Boston.
Greeley, M. H.,	Engineer	"	South Boston.
Hogan, E. J.,	"	"	South Boston.
Kane, N. J.,	Seaman	"	Whitman.
Liverpool, H. J.,	Engineer	"	Boston.
Lemp, H. J. G.,	"	"	Lynn.
McGarry, J. S.,	"	"	Shrewsbury.
O'Connell, B.,	Seaman	"	Peabody.
Powers, E. E.,	Engineer	"	Cambridgeport.
Shaw, G. M.,	"	"	Springfield.
Smith, C. N.,	Seaman	"	Plymouth.
Spear, H. W.,	Engineer	"	Malden.
Taisey, P. C.,	"	"	Lowell.
Woodbury, M.,	Seaman	"	Townsend.
Wyman, A. E.,	"	"	Winthrop.
Waite, H. R.,	"	"	Winthrop.
Webber, C. W.,	"	"	Cambridge.
Wells, R. A.,	"	"	Greenfield.
Whitman, R. W.,	Engineer	"	Roxbury.
Young, E. H.,	"	"	Upton.

Class to Graduate October, 1903.

Cunningham, S.,	Seaman	Cadet,	Cambridge.
Conley, J. A.,	Engineer	"	Rockport.
Cashman, W. P.,	"	"	Lynn.
de L'Etoile, A. J.,	Seaman	"	Boston.
Fernald, H. V.,	"	"	Charlestown.
Garvin, E. W. P.,	"	"	South Boston.
Garland, F. S.,	Engineer	"	Randolph.
Goodwin, C. W.,	"	"	Melrose.
Hudson, G. H.,	"	"	Somerville.
Jones, C. T.,	Seaman	"	Roxbury.
Jones, R. C.,	Engineer	"	Fitchburg.
Komenda, R.,	"	"	Somerville.
Lowe, H. A.,	Seaman	"	Roxbury.
Mercer, E. A.,	Engineer	"	Cambridge.

Nye, R. H.,	Engineer Cadet,	North Falmouth.
O'Neil, T. J.,	" "	Worcester.
Orr, H. S.,	" "	North Adams.
Powers, R. B.,	Seaman "	Brockton.
Rich, E. C.,	" "	Roxbury.
Rideout, H. C.,	" "	Concord Junction.
Rice, L. P.,	Engineer "	Quincy.
Snowdale, W. W.,	" "	Stoughton.
Shields, W. J.,	" "	Boston.
Thompson, H. A.,	Seaman "	South Framingham.
Woodbury, V.,	" "	Townsend.
Woodbury, E. F. M.,	" "	East Boston.
Woodbridge, F. D., Jr.,	Engineer "	Wakefield.
Young, R. W.,	Seaman "	Boston.

APPROPRIATIONS.

The appropriations for the school for the year 1901, which are here accounted for, were: —

Current Expenses.

Appropriation,		$50,000 00
Expended: —		
Pay roll,	$23,875 95	
Provisions,	12,056 79	
Text-books, instruments, etc.,	368 78	
Seamanship department,	2,887 25	
Engineer department,	5,278 03	
Miscellaneous,	5,502 64	
Total amount expended,		49,969 44
Balance unexpended,		$30 56

Office Expenses.

Appropriation,		$5,000 00
Expended: —		
Salaries,	$3,432 00	
Commissioners' expenses,	249 15	
Miscellaneous,	1,218 02	
Total amount expended,		4,899 17
Balance unexpended,		$100 83

Respectfully submitted,

GEO. E. BELKNAP, *Chairman*,
REAR ADMIRAL, U. S. N. (Retired), LL.D.,
ROBERT B. DIXON, M.D.,
HON. JOHN READ, LATE U. S. N.,
Board of Commissioners.

BOSTON, Jan. 2, 1902.

INFORMATION REGARDING GRADUATES OF THE SCHOOL.

The commissioners have been gratified to learn, through the record of graduates carefully kept in this office, of the steady and substantial progress made by the seaman and engineer graduates of the school. The reports received during the past year, of the young men who have gone out from the school to enter the merchant service, have been of a very encouraging nature, and show the abundant success attending the work of the State in its endeavor to educate young seamen as officers for our American mercantile marine.

The increase in the number of steamships built during the last three years and the large number of vessels launched from Maine ship yards have materially enlarged the heretofore limited opportunities afforded by our merchant marine for young seamen. Our graduates are gradually taking their places on the decks or in the engine departments of steamers of the different steamship lines of the country. Young seamen or engineers from this school are now found in the steamers of the American Hawaiian Steamship Company, Pacific Mail Steamship Company, Empire Line, New York & Puerto Rico Steamship Company, Ward Line, Morgan Line, Clyde Line, "Red D" Line, American Line, Atlantic Transport Company, Leyland Line, Plant Line, Joy Steamship Company, Boston & Philadelphia Steamship Company, Metropolitan Line, Merchant and Miners Transportation Company, Boston Towboat Company and other lines.

The following extracts from a few of the communications received at the office of the commissioners, from graduates or their parents, will be of interest in showing the work taken up by the cadets after leaving the school: —

Fred'k A. Sparks of Provincetown, third officer of the U. S. army transport "Sumner," writes: "I always take a great interest in everything connected with the school, as the instruction I received has been very beneficial. I have met a number of ex-cadets and will give the whereabouts of a few of them. George R. Lauriat is second officer of the U. S. A. transport 'Sumner;' Charles W. Clift is third officer of the Empire Line steamer 'Ohio;' Willis Howes is quartermaster of the Spreckels Line steamer 'Mariposa;' Joseph E. Sheedy is third assistant engineer of the transport 'Egbert;' and Herbert R. Spencer is captain and part owner in brig 'Pitcairn,' used in the inter-island trade of the Philippines."

Harry E. Richardson of Medford writes from Adelaide, South Australia: "I have been out here trading between the colonies, and will sail in a few weeks for San Francisco on board the American bark 'Himalaya.' Upon our arrival in San Francisco I intend to take the examination for mate."

Edward Smith, Wellesley: "I served as seaman on the tramp steamer 'Pleiades,' running between Boston and Norfolk, and am now quartermaster of the steamer 'Grecian.' I shall apply for second officer's papers next April. There is nothing like the 'Enterprise' to give a young man who desires to follow the sea a start."

Mr. Herbert R. Cummings, Worcester: "My son secured a position in February as a deck cadet on the S. S. 'St. Louis,' and was promoted in May to cadet quartermaster. In August he was appointed quartermaster of the 'Philadelphia.' My son has had several offers from other lines. The Nautical Training School was the making of the boy."

Mr. Chas. F. Harrington, Boston: "My son is quartermaster of the S. S. 'Lyra,' at present running between Boston and Newport News. I am greatly pleased with my son's progress, due to the training received on the 'Enterprise.' I believe the school to be a fine institution for the development of officers for the American merchant marine."

Mrs. Julia Scanlon, North Easton: "My son is at present working in the engine department of the Geo. Lawley & Son Corporation. The training received in your school is very valuable, and any boy can be benefited by it."

Gershom Bradford, Millbrook: "I first served as recorder on board the U. S. coast survey steamer 'Eagre.' I am now third deck officer on board the coast survey steamer 'Endeavor' in Chesapeake Bay."

Mr. J. Willard Cutts, Stoneham: "My son is quartermaster on board the 'Admiral Sampson.' The school is doing a good work; if any one wishes to follow the sea, your school is the one to attend."

Mr. William B. Stevens, Nantucket: "My son has served in the engine department of the S. S. 'Admiral Farragut.' Later he was assistant engineer of the 'Admiral Dewey,' and is now assistant engineer of the S. S. 'Ponce' of the New York & Puerto Rico Steamship Company. I am very well pleased with the training my son received, and I consider the Nautical Training School a good school."

Mrs. Mary C. Howley, Weymouth: "My son is at present engineer on board the steamer 'Seneca' of New York. I consider the Nautical Training School a splendid opportunity for a boy who desires to follow the sea; it gives him a good start in life. I am sure my son has profited by what he learned during his course in marine engineering."

Albert S. Warner, Waverley: "I have been mate of the schooner 'William F. Campbell.' I obtained my license as master in Baltimore, covering all sail vessels in all waters, and I am in hopes of being master of a vessel before long."

Miss Annie M. Sullivan, Randolph: "My ward, ex-cadet James H. Barry, is employed in the engine department of the steamship 'Admiral Dewey.' He always spoke very highly of the work of the school, and the officers in charge."

Adam M. Queen, Highlandville, was appointed in September, 1900, quartermaster on board the steamer "Kershaw." In July, 1901, he was promoted to second officer, and in September last he served as executive officer of the steamer "State of Texas" of the Merchant and Miners Transportation Company. He holds a license as mate.

Albert F. Patterson, Townsend, first served as engineer cadet of the "St. Louis." He afterwards was appointed fourth assistant engineer of the army transport "Sumner," and is now first assistant engineer of the Philippine Islands transport "Liscum."

Emery Rice, Brighton, has been quartermaster and fourth officer of steamers of the American Line, and is at present second officer of the new steamer " Oregonian " of the American-Hawaiian Steamship Company.

Joseph W. McGrath, Quincy, holds a license as mate, and is second officer of the coast survey steamer " Gedney." He previously served as fourth watch officer of the coast survey steamer " Pathfinder," and as chief master-at-arms of the coast survey steamer " Bache."

Joseph E. Gately of Marlborough was for three months a seaman cadet on board the steamer " New York," when he was promoted to quartermaster. After a service of nine months as chief quartermaster he was given an appointment as fourth officer of the new 12,000 ton steel steamship " Vaderland " of the Red Star Line, plying between New York and Antwerp.

LEGAL AUTHORITY FOR THE SCHOOL.

AUTHORITY OF THE UNITED STATES.

[CHAPTER 339, June 20, 1874.]

AN ACT TO ENCOURAGE THE ESTABLISHMENT OF PUBLIC MARINE SCHOOLS.

That the secretary of the navy, to promote nautical education, is hereby authorized and empowered to furnish, upon the application in writing of the governor of the State, a suitable vessel of the navy, with all her apparel, charts, books and instruments of navigation, provided the same can be spared without detriment to the naval service, to be used for the benefit of any nautical school or college having a branch established at each or any of the ports of New York, Boston, Philadelphia, Baltimore, Norfolk, San Francisco, Washington, Charleston, Savannah, Mobile, New Orleans, Baton Rouge, Galveston, and in Narragansett Bay (Acts, 1881), upon the condition that there shall be maintained at such port a school, or branch of a school, for the instruction of youths in navigation, seamanship, marine enginery and all matters pertaining to the proper construction, equipment and sailing of vessels, or any particular branch thereof.

And the president of the United States is hereby authorized, when in his opinion the same can be done without detriment to the public service, to detail proper officers of the navy as superintendents of or instructors in such schools: *provided*, that if any such school shall be discontinued, or the good of the naval service shall require it, such vessel shall be immediately restored to the secretary of the navy, and the officers so detailed recalled; and *provided*, *further*, that no person shall be sentenced to or received at such schools as a punishment, or commutation of punishment, for crime.

AUTHORITY OF THE STATE OF MASSACHUSETTS.

[CHAPTER 402.]

AN ACT TO ESTABLISH A NAUTICAL TRAINING SCHOOL.

Be it enacted, etc., as follows:

SECTION 1. The governor with the advice and consent of the council shall appoint, as soon as practicable after the passage of this act, three citizens of this Commonwealth, who shall constitute a board of commissioners of the Massachusetts nautical training school, and who shall hold office for terms of one, two and three years respectively, from the first day of July in the year eighteen hundred and ninety-one, and until their successors are appointed and qualified; and before the first day in July in each year thereafter one commissioner shall be appointed in like manner, to hold office for the term of three years. Vacancies may be filled for the residue of a term by appointment, and a commissioner may be removed at any time for cause, to be stated in the order of removal. All appointments and removals shall be made by the governor with the advice and consent of the council.

SECT. 2. Said commissioners shall serve without compensation, but they shall be reimbursed from the treasury of the Commonwealth for all expenses actually incurred by them in the performance of their official duties.

SECT. 3. Said commissioners shall provide and maintain a nautical training school for the instruction and training of pupils in the science and practice of navigation; shall furnish accommodations for the school on board a proper vessel; shall from time to time purchase and provide such books, stationery, apparatus and supplies as are needed in the work of the school; shall appoint and remove instructors and other necessary employees, and determine their compensation; shall fix the terms and conditions upon which pupils shall be received and instructed in the school, and discharged or dismissed therefrom; and shall establish all rules and regulations necessary for the management of the school. For the purpose of giving the pupils of the school a practical knowledge of navigation and the duties of mariners, said commissioners shall from time to time provide for the making of cruises in or from the harbor of Boston.

SECT. 4. Said commissioners are authorized to receive from the United States government, and to use for the accommodation of the school, such vessel or vessels as the secretary of the navy may detail for that purpose.

SECT. 5. In order to properly maintain the said nautical training school, the commissioners may expend a sum not exceeding fifty thousand dollars, which shall be paid from the treasury of the Commonwealth on properly approved vouchers, which shall be approved by the governor and council and presented to the auditor of the Commonwealth for allowance in the same manner as other claims against the Commonwealth: *provided, however*, that no expenditure shall be made or allowed until a vessel suitable for the proposed nautical training school shall have been furnished by the United States government and turned over to the Commonwealth, and the same approved of and accepted by the governor and council.

SECT. 6. Said commissioners shall annually in the month of January make a report to the legislature, presenting a detailed statement of all moneys appropriated and expended for the purposes of the nautical training school during the year preceding; also stating the results of the work during such year, and making such recommendations as seem to them proper.

SECT. 7. This act shall take effect upon its passage.

[*Approved June 11, 1891.*

VOTE OF EXECUTIVE COUNCIL UPON ACCEPTANCE BY THE COMMONWEALTH OF MASSACHUSETTS.

COMMONWEALTH OF MASSACHUSETTS,
COUNCIL CHAMBER, BOSTON, Nov. 9, 1892.

The committee on Military Affairs, to whom was referred the matter of the approval of the United States ship Enterprise for the purpose of a nautical training school, submit the following report.

E. V. MITCHELL, *for the Committee.*

Chapter 402 of the Acts of the year 1891 provides for the establishment of a nautical training school in this Commonwealth, and section 2 of said act authorizes an expenditure of fifty thousand dollars to properly maintain the proposed school, and also provides for the furnishing by the United States government of a suitable vessel for such school which shall be turned over to the Commonwealth and accepted by the Governor and Council; and whereas, the United States having furnished a suitable vessel and the same having been examined by the Executive Council, it is hereby *Ordered*, That the United States ship Enterprise be approved and accepted for the proposed nautical training school.

Approved in council, Nov. 9, 1892.

E. F. HAMLIN, *Executive Clerk.*

A true copy.

Attest: E. F. HAMLIN, *Executive Clerk.*

MASSACHUSETTS NAUTICAL TRAINING SCHOOL.

Establishment.

Under the authority of the above acts, the Secretary of the Navy, on Oct. 28, 1892, turned over to the authorities of the State of Massachusetts the United States steam sloop of war Enterprise, as a vessel suitable for the purpose.

PUBLIC DOCUMENT . . . . No. 48.

REPORT

OF THE

BOARD OF METROPOLITAN PARK COMMISSIONERS.

JANUARY, 1902.

BOSTON:
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Commonwealth of Massachusetts.

REPORT.

The Metropolitan Park Commission presents herewith its ninth annual report.

The Commission is charged with the work of caring for and maintaining a system of greater parks, or reservations as they are more frequently called, and parkways or boulevards, for the Metropolitan Parks District. This district comprises Boston and thirty-eight neighboring cities and towns, all within a radius of thirteen miles from the State House. The general features of the plan for this park system were described in a report made by a preliminary commission to the Legislature of 1893, and have been adhered to with great fidelity.

In brief, the plan then outlined was to preserve as much as possible of the most characteristic scenery of the Metropolitan District by acquiring such portions as were likely to be useful as recreation grounds, and to connect these areas or open spaces with each other and with the more important parks and parkways which the separate municipalities were providing at their own expense. While the fundamental idea of the plan was that of preserving these desirable open spaces without regard to their locality, yet the unique and widely varied topography of Boston and its suburbs not only permitted but almost dictated their equitable distribution throughout the entire district; and so it has resulted that the people of every portion of the district have felt an extraordinary interest in the gradual acquirement and development of the Metropolitan Park System, and have been drawn together in a remarkable unity of feeling in regard to it. Local pride has been well satisfied either by the actual acquirements and developments as they have been made, or by the expectation of a gradual completion of the system; and a very gratifying freedom from effort to secure merely local advantages by acquirements or construction not contemplated by the original plan has resulted.

Appropriations for this Metropolitan work have been made from year to year in general form, each appropriation being added to the original loan, and all forming at this time three separate loans, which now aggregate about $10,000,000. These loans are the Metropolitan Parks Loan, beginning with that under the Park Act, chapter 407 of the Acts of 1893, which created the Commission and defined its powers; the Metropolitan Parks Loan, Series II., beginning with the first appropriation for boulevards and parkways, chapter 288 of the Acts of 1894; and the Nantasket Beach Loan, beginning with the appropriation under chapter 464 of the Acts of 1899, which specifically authorized the acquirement of Nantasket Beach.

Under the Park Acts have been acquired the woods reservations, Blue Hills, Middlesex Fells, Stony Brook and Beaver Brook; the banks of Charles, Mystic and Neponset rivers; and seashore at Revere Beach, King's Beach, Lynn, Winthrop and Quincy. These provide for practically all the parks originally recommended, and of the portions not yet acquired only a few miles are of immediate importance to the system. Of the land necessary to provide for all the parkways required to connect these reservations and unite the principal park areas of the district, two-thirds of the entire projected system have been acquired, and construction of about one-half has been fully completed. Nantasket Beach, although one of the great reservations of the district, is peculiarly isolated. It was acquired under a special act which required Cohasset, although out of the Parks District, to share the expense of its acquirement and maintenance. This apparently anomalous arrangement was assented to by Cohasset in the expectation that the reservation would finally extend into that town so as to include the interesting cliffs at the southerly end of Nantasket Beach and Straits Pond at the beginning of the beautiful Jerusalem Road; but the

Commission has not yet been able to extend its taking to include these attractive features. Full statistics as to the appropriations and acquirements will be found in the accompanying reports and plan submitted herewith, but they may be briefly summarized as follows: —

	Park.	Boulevard.	Nantasket.
Appropriations prior to 1901, ...	$6,205,000 00	$3,025,000 00	$600,000 00
Miscellaneous receipts prior to 1901, . . .	161,073 69	21,736 77	4,975 00
Appropriations, 1901, ...	650,000 00	-	100,000 00
Miscellaneous receipts, 1901, ...	37,260 32	8,170 64	906 50
Totals, ...	$7,053,334 01	$3,054,907 41	$705,881 50

The appropriations made in 1901 were understood to be for the settlement of the balance of claims then outstanding, and not to provide for any new acquirements. For that reason, no important new acquirements have been made during the past year. The areas of the reservations and parkways may be summarized as follows: —

Under Park Acts.

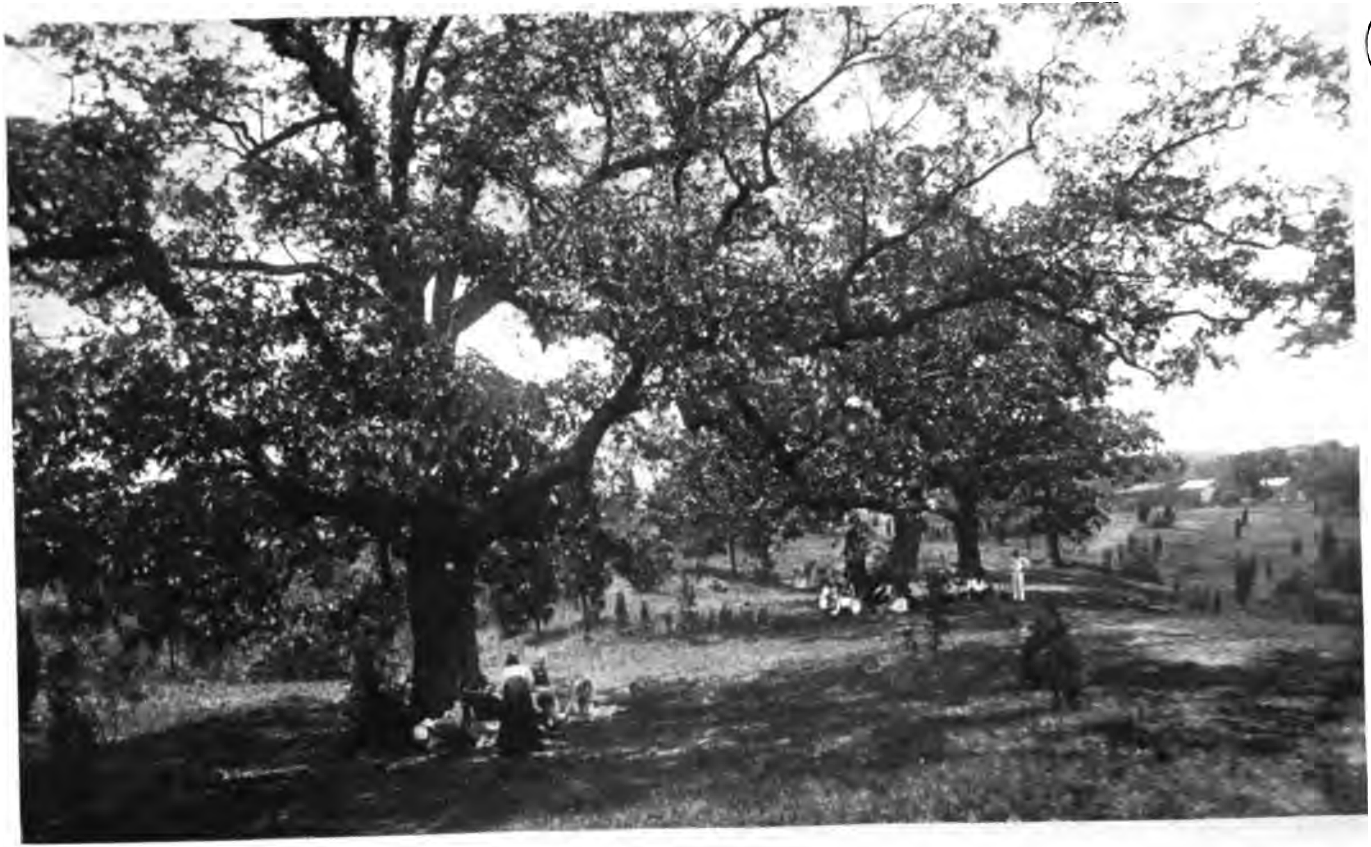
	Miles.	Acres.	Total.
Woods reservations: —			
Blue Hills, ...		4,857.96	
Middlesex Fells (in addition to 1,145.03 held by water boards), ...		1,882.95	
Stony Brook, ...		463.72	
Beaver Brook, ...		58.35	
Hart's Hill, ...		23.09	
Hemlock Gorge, ...		23.11	
			7,309.18
River banks: —			
Charles, ...	16.500	562.84	
Mystic, ...	5.000	289.44	
Neponset, ...	9.000	928.83	
			1,781.11
	30.000		
Seashore: —			
Revere, ...	2.710	67.34	
Winthrop, ...	1.320	16.74	
King's Beach, ...	.690	10.81	
Quincy Shore, ...	2.000	37.97	
Nantasket, ...	1.017	24.51	
			157.37
	7.737		
			9,247.66

Under Boulevard Acts.

Parkways: —	Miles	Total.
Blue Hills,	2.280	
Middlesex Fells,	4.605	
Revere Beach,	5.240	
Mystic Valley,	2.900	
West Roxbury,	1.510	
Neponset River,	1.120	
Fresh Pond,	.520	
Furnace Brook,	2.540	
Nahant Beach,	2.230	
Lynnway, Revere Beach to Saugus River,	.690	
		23.635

These areas do not include the river surfaces, nor in Middlesex Fells the holdings of the Metropolitan Water Board and those of the city of Medford in the neighborhood of Spot Pond, aggregating 1,145.03 acres, nor do they include the park or other public open spaces owned by the separate municipalities of the Parks District.

The claims arising out of the acquirement of the large areas now placed under the care of this Commission have been very numerous, representing those of over 3,000 different claimants. Of this large number of claims, 325 claims remained unadjusted Dec. 1, 1901, of which 218 were for takings under the Park Acts, and 107 were for takings under the Boulevard Act. The unsettled claims at Nantasket Beach are few, and aggregate only a small amount. Of these claims, 142 were in suit. The balance on hand for the settlement of claims against the Park Loans and the Nantasket Beach Loan now appears sufficient. The balance on hand for settlement of claims against Metropolitan Parks Loan, Series II., is clearly insufficient to settle either the outstanding land claims or to provide for certain acquirements and construction which the Legislature intended to provide for in the general appropriations of previous years. The deficiency under this loan represents the final summing up of the claims for takings under the Boulevard Act since the beginning of the work, and is occasioned chiefly by the fact that the appropriations have been based by the Legislature upon preliminary estimates of the value of lands proposed to be taken, and have not included any allowance for the interest and expenses



BEAVER BROOK RESERVATION.—PICNICKERS.

UNIV. OF MICH.

likely to result from long delays before settlement, and especially before contested claims can be brought to trial, nor for the incidental expense of engineering. Interest runs on all these claims at six per cent. In each claim the claimant is allowed two years within which to decide whether to contest the award of the Commission, and delays in the trial of suits prolong the interest period thereafter from six months to three years, to the expense of which must be added, in making up the final cost of the settlement of each claim, the expense of trial of suits, and any possible variation of the opinion of the jury as to the value of the claim. In addition to these expenses, over which the Commission has no control, there has been especial difficulty in accurately forecasting the claims under the Boulevard Act, because the takings for boulevards and parkways necessarily consist of long strips of land following the line of the parkway, and so cutting off from the several owners small, irregular pieces of land. Takings of this sort naturally cause claims for incidental damages altogether out of proportion to the general appraised value per foot of the same land as represented by lot sales in the neighborhood. While a very large proportion of the claims have been settled successfully, the aggregate of all these items of incidental expense has exhausted the appropriations made, as before noted; and the Commission will be obliged to ask for an appropriation under the Boulevard Act to enable it to settle the balance of claims now outstanding, and to restore amounts supposed to be available for certain takings and construction previously authorized by appropriations which have been exhausted to pay for lands already taken. In view of the uncertainty as to when the matter of apportionment of the district liabilities to the Commonwealth will be determined, the Commission will not urge any further appropriation except for the annual expense of care and maintenance.

As already pointed out, no acquirements of importance have been made during the past year. New work has been chiefly that of Revere Beach Parkway, construction of Mattapan Bridge, a single roadway for Whitmore Brook Entrance to Middlesex Fells, the grading of Manchester Field, and construction commenced on Charles River Road from the Arsenal to Watertown Landing. Plans have also been prepared for the acquirement and construction of Wellington Bridge, as authorized and directed by chapter 491 of the Acts of 1901. As soon as these plans are approved by the United States Government, the Harbor and Land Commission, the County Commissioners of Middlesex, and the cities of Medford and Somerville, contracts for construction can be made. Mattapan Bridge between Blue Hill Avenue and Blue Hill Parkway at Mattapan is well under way, and will probably be completed early in the coming summer. Revere Beach Parkway is practically completed from Main Street in Everett to Revere Beach, with the exception of the bridge at Revere Station, which is to be provided during the coming year in connection with the abolishment of the grade crossing of the Boston & Maine Railroad at this point. Considerable improvements have been made at Nantasket Beach. The headquarters building has been completed, and plans are under way for a new bath-house. A special report has been prepared for a bath-house and shelter buildings at Nahant Beach, as required by chapter 107 of the Resolves of 1901.

The reservations and parkways have been used by more people during the past year than in any other previous year. The increase has been so marked at the beaches, that, in spite of the large accommodations of previous years, it has been necessary to increase those of the bath-house at Revere Beach by altering the bicycle storage room into a dressing room for boys, and by providing additional sanitary buildings, and to plan for a new bath-house at Nantasket Beach, to be operated under the direct supervision of the Commission. Additional sanitary and shelter buildings are needed at the Revere Street entrance to Revere Beach, and it is hoped that the sanitary building may be provided at once; but no provision can be made for shelters until the present inadequate entrance road and bridge at this point are improved. No important improvements or developments have been made upon the Mystic or Neponset rivers, except cleaning off old buildings and debris. Many claims for takings of land along these rivers are now in suit, and it is deemed wise not to begin greater improvements until after the trial of these suits. Considerable improvements have been made at small expense by the small forces employed on both the upper and lower portions of Charles River, and the general care and protection extended to the public has made the Speedway more attractive than in any previous year, and has preserved order, added to the general convenience, and resulted in saving 42 lives on the upper river.

The proper care of the woods reservations is in some ways the most difficult problem of each year's work. These reservations have an increasing use from year to year, and it is already apparent that present provisions for safety will soon be inadequate. Keeping down fire has allowed a great increase of the indiscriminate sort of forest growth which shelters all sorts of insect pests, and in which the worst varieties throttle and take sustenance from the better ones, and the development of a fine tree growth becomes a process of "survival of the fittest." Such indiscriminate growth not only retards the development of the better trees, but also in time makes the policing of the reservations more difficult, shuts out the best interior views and the outlook from the hilltops, and makes portions of the reservations almost impenetrable. The care of these reservations therefore seems to require that the most beautiful vistas be kept open; that coarse and indiscriminate trees be eradicated from the sections where the finer and rarer ones will grow; that new ones be planted where fire has destroyed all but scrub growth; and that the tree and shrub growth generally be limited by removal of the weak and diseased kinds, that foster insect pests, and by leaving only so many of healthy and desirable trees as the soil will sustain. Such work done at this time and patiently pursued from year to year according to a definite plan means a small annual outlay, while it insures future economy and an increasing return upon the present investment. The Commission has not yet been able to satisfy itself, nor those expert in forestry matters, in the woods reservations, for the simple reason that the problems of policing and of the building and care of the roads and bath-houses required for present use, added to those of the beach and river requirements, have largely occupied its attention and required all the appropriations placed at its disposal, and for the further reason that the mere mention of the word "forestry" has seemed to those not familiar with the reservations to suggest extravagance, and to be an unnecessary item of appropriation.

With the increasing public use of the reservations the expense of care and maintenance has somewhat increased, until it now amounts to a very considerable annual sum, and naturally causes some disinclination to further appropriation for anything which seems like an unusual item of care and maintenance, or of the sort which appeals only to those most expert or most conversant with the best method of development. It is therefore likely that such special interests as the care and preservation of the trees, that is, adequate forestry, or the more perfect and beautiful construction of such structures as bridges which it is desirable to build of a monumental character, may be postponed or be impossible, unless they are made to some extent the object of private interest and benefaction. The Metropolitan Park System is now of a size and character which places it within the ranks of the best in the world, and seems worthy of the attention of those wealthy and public-spirited citizens of the Commonwealth whose thought has been so quickened by travel and observation that they wish to create some monumental improvement of the highest usefulness, which shall be at once both a memorial to themselves and an addition to the treasures of the State. It was the hope of the preliminary commission that the time would come when such gifts would be as naturally thought of as those to art museums, hospitals and other institutions of public importance; and provision was therefore made in the original Park Act for a trust fund, to be held by the Treasurer of the Commonwealth, and its income devoted to the specific purposes which might be designated by the donors. Wise gifts of this sort which can be suggested by the Commission are much needed, and may be made of immediate benefit as well as enduring form.

It is a pleasure at the close of the year to record the general enthusiasm and efficiency of the various forces engaged in the care of the reservations and parkways, and their sincere effort to serve the public with fidelity and courtesy. This is true of both the superintendents and of the police and laborers as well. The difficulty of keeping a police force which requires nearly twice as many men in summer as in winter has been overcome by placing reserve police at work in the reservations during the winter, and by assigning portions of the regular or winter forces in rotation to similar work; and, as a rule, all have cheerfully joined in this assignment. In the general office and engineering forces some reduction has been made by uniting the claims and conveyancing departments, by reducing the numbers employed during the winter in the engineering department, and by assigning to those remaining a greater variety of work.

The usual accompanying reports are submitted herewith, together with a reprint of the reports of the Apportionment Commission and a reprint of the special report by this Commission in the matter of a bath-house at Nahant Beach.

All of which is respectfully submitted,

WILLIAM B. DE LAS CASAS.
EDWIN B. HASKELL.
EDWIN U. CURTIS.
DAVID N. SKILLINGS.
ELLERTON P. WHITNEY.

DEC. 11, 1901.

REPORT OF THE SECRETARY.

Hon. WILLIAM B. DE LAS CASAS,
Chairman Metropolitan Park Commission.

SIR:—I herewith present my report for the year ending Dec. 1, 1901. It is subdivided as follows: 1. Acquirement of lands. 2. Administration. 3. Miscellaneous. 4. Finances.

1. ACQUIREMENT OF LANDS.

No takings of land have been made this year for any reservations or parkways not already described in previous reports. There have been, however, in some cases additional takings and abandonments affecting the boundaries of several of the existing reservations and parkways, which are noted below. For convenience of reference, I submit a list and short description of the holdings of the Metropolitan Park System, noting under the proper head any changes of importance which have occurred since the last report.

Blue Hills Reservation.

This is a forest reservation, including within its limits the entire range of the Blue Hills and several ponds. Its total area is 4,857.96 acres, of which 2,562.57 acres are in the city of Quincy, 1,499.42 acres in the town of Milton, 67.84 acres in the town of Braintree, 471.13 acres in the town of Canton and 257 acres in the town of Randolph.

Middlesex Fells Reservation.

This is a forest reservation, which, with the holdings of the Metropolitan Water Board and the local boards of Medford and Winchester, includes substantially all of the region which, on account of its peculiar characteristics, has been known for many years as the Middlesex Fells. This Commission directly controls 1,882.95 acres, of which 726.15 acres are in the town of Stoneham, 177.54 acres in the city of Melrose, 59.57 acres in the city of Malden, 669.08 acres in the city of Medford and 250.61 acres in the town of Winchester. The area of Water Board holdings is 1,145.03 acres, which, under an agreement with these boards, is used by the public in the same manner and to the same extent as the park lands. This makes the Fells a public reservation of 3,027.97 acres. There are many beautiful sheets of water in the Fells, of which the largest and best known is Spot Pond, now the northern distributing reservoir of the Metropolitan Water System. Through an unavoidable error, omission was made in the last report of the name of Mr. Shepard Brooks as one of the givers of land for the Whitmore Brook Entrance to the Middlesex Fells from West Medford.

Stony Brook Reservation.

This is a forest reservation, of 463.72 acres, of which 195.16 acres are in the city of Boston and 268.56 acres in the town of Hyde Park. Turtle Pond, the source of Stony Brook, is situated in the centre of the reservation, and there is also a skating pond at the Hyde Park boundary.

Beaver Brook Reservation.

This reservation contains 58.35 acres, of which 15.58 acres are in the town of Belmont and 42.77 acres are in the city of Waltham. In the northerly part of the reservation, which is beautifully wooded, are two ponds and a picturesque cascade. In the southern portion are the Waverley Oaks.

Hart's Hill Reservation.

This reservation, which contains 23.09 acres, was acquired in co-operation with the town of Wakefield, which paid one-half of the cost thereof. The lands, which comprise a wooded hill commanding an extensive view of that portion of the district, have been transferred to the care and control of the Park Commission of the town, which assumes the cost of its maintenance. Hart's Hill immediately overlooks Crystal Lake, in the southern portion of Wakefield.

Hemlock Gorge Reservation.

This reservation is at the head of the takings on the Charles River, and contains 23.11 acres, of which 4.27 acres are in the city of Newton, 14.24 acres in the town of Needham and 4.60 acres in the town of Wellesley. In addition to the ledges which give the reservation its name, it contains an interesting tree growth. The reservation is bisected by the Sudbury River Aqueduct of the Metropolitan Water System, which here crosses the Charles River by Echo Bridge with its single span of 129 feet.

Charles River Reservation.

This longest of the river reservations extends, with slight breaks in continuity, from Hemlock Gorge at Newton Upper Falls to Essex Street Bridge at Cottage Farms in Boston, a distance of 16½ miles. It contains 562.84 acres of river bank of varying width, of which 143.43 acres are in the city of Boston, 38.07 acres in the city of Cambridge, 124.09 acres in the city of Newton, 38.20 acres in the city of Waltham, 75.21 acres in the town of Watertown, 76.71 acres in the town of Weston and 67.13 acres in the town of Wellesley This year a strip of land for a canoeway has been taken at Newton Lower Falls, between the Cordingly and Crehore Mills.

Mystic River Reservation.

This reservation includes the greater part of the river banks from Weir Bridge at the outlet of the lower Mystic Pond to Cradock Bridge in Medford. From this point to Wellington Bridge the banks in Medford have been acquired by that city, and will later be transferred to this Commission for development. The whole reservation (including the lands to be transferred by the city of Medford) contains 289.44 acres, of which 15.18 acres are in the town of Arlington, 265.43 acres in the city of Medford and 8.83 acres in the city of Somerville. The distance from Weir Bridge to Wellington Bridge is 5 miles.

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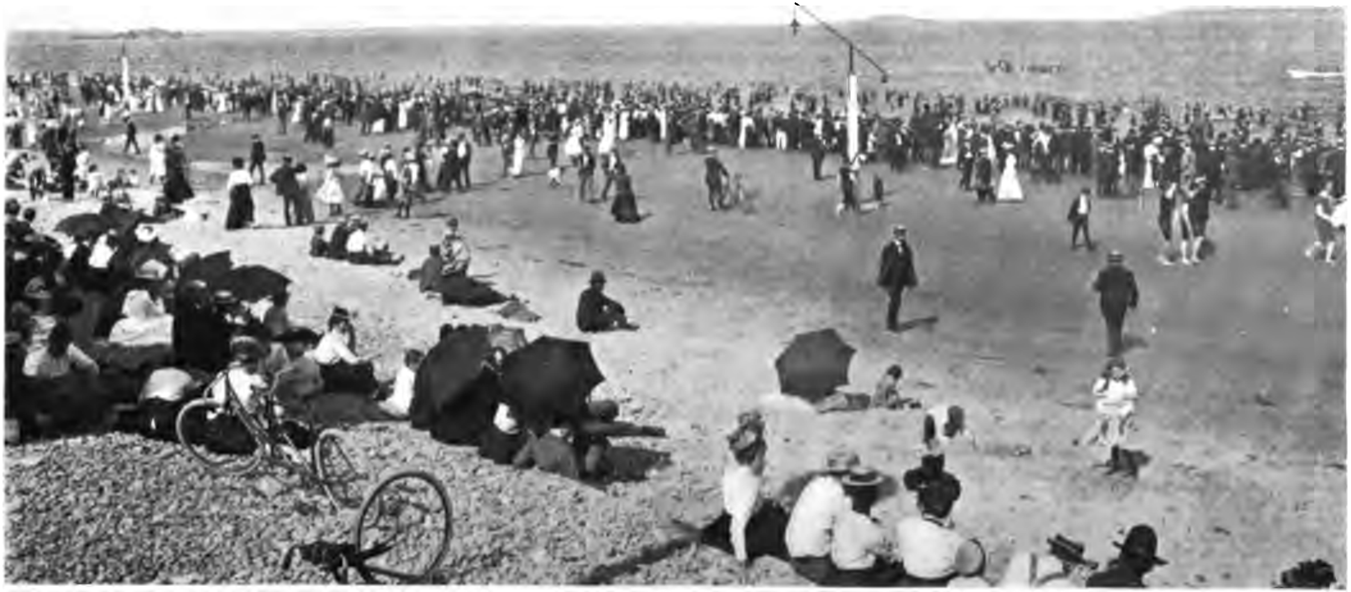

REVERE BEACH RESERVATION.—A SATURDAY AFTERNOON.

Neponset River Reservation.

This reservation begins with the broad reaches of the Fowl Meadows at Green Lodge Street in Canton and Dedham. Below Paul's Bridge the takings are of such portions of the banks as could be obtained within the limits of the appropriations without interfering with important manufacturing plants. Below Milton Lower Mills the takings, however, include practically all the Neponset Marshes down to Granite Avenue Bridge, where the reservation ends. The total area of the river banks acquired is 928.83 acres, of which 81.36 acres are in the city of Boston, 271.75 acres in the town of Milton, 265.41 acres in the town of Canton, 68.21 acres in the town of Hyde Park, 234.70 acres in the town of Dedham and 7.40 acres in the town of Westwood. In several places slight changes have been made this year in the boundary line, to facilitate settlement and reduce the cost.

King's Beach and Lynn Shore Reservations.

These reservations, though taken at different times, practically form one reservation, which includes, substantially, all of King's Beach in Swampscott and Lynn. The total length of the beach is .69 mile and the area of the upland is 10.81 acres, of which 3.30 acres are in the town of Swampscott and 7.51 acres in the city of Lynn. The original plan for the Lynn Shore Reservation provided for its continuation along the shore to the beginning of the Nahant Beach Parkway; but the first appropriation was insufficient to carry out the entire plan, and no further appropriation has been made for this purpose.

Revere Beach Reservation.

This reservation is wholly in the town of Revere. It contains 67.34 acres of upland, and the beach, which extends from the Point of Pines to Beachmont, is 2.71 miles in length.

Winthrop Shore Reservation.

This reservation is wholly in Winthrop. It contains 16.74 acres, and the portion of the beach acquired from Grover's Cliff to the foot of Great Head is 1.32 miles in length.

Quincy Shore Reservation.

This reservation includes the shore on Boston harbor in Quincy from Moswetusset Hummock on the peninsula of Squantum to the National Sailors' Home on Black's Creek, together with lands for a connection at one end with Hancock Street at Atlantic and at the other with Merry Mount Park, an open space of the city of Quincy. It contains 37.97 acres of upland, and the length along the shore is 2 miles.

Nantasket Beach Reservation.

The portion of the beach acquired for the reservation extends northerly from Atlantic Hill 1.017 miles. The portion of Nantasket Avenue abutting on the reservation is also under the control of this Commission, by a special statute. A parcel of land in the rear of Nantasket Avenue and between that street and the railroad station and steamboat wharf was also acquired as a part of the reservation, and is mostly used for administrative purposes. The area of upland in the reservation is 24.51 acres.

Blue Hills Parkway.

This parkway extends from the Neponset River at Mattapan Square to the Blue Hills. Its total length is 2.28 miles. It is all in Milton, with the exception of the lands on the Boston bank of the river taken this year to provide for the abutments of the Mattapan Bridge now in course of building. In connection with these takings and in carrying out agreements with the New York, New Haven & Hartford Railroad, exchanges of land were made with the railroad company to provide for a new station in place of the old Mattapan station, which had to be removed to make way for the approaches to the new bridge. This parkway has already been constructed from the river to Canton Avenue, and a short connection from this point has also been made to Harland Street.

Middlesex Fells Parkway.

This parkway is divided into three sections: Fellsway, 2.442 miles long; Fellsway East, 1.114 miles long; and Fellsway West, 1.049 miles long, — a total of 4.605 miles, of which .74 mile is in the city of Somerville, 2.35 miles in the city of Medford and 1.515 miles in the city of Malden. There has been no change in its boundaries since the last report. Plans for some slight changes, however, are in preparation to provide proper approaches to the bridge which the Commission is about to build across the Mystic River. This parkway has been constructed its entire length from Broadway Park in Somerville to both the eastern and western sections of the Middlesex Fells.

Revere Beach Parkway.

This is the longest parkway of the system. Starting from the point of intersection in Medford of the Middlesex Fells Parkway and the proposed north border road of the Mystic River Reservation, it runs to the Malden River, and passes through Everett, Chelsea and Revere to the southern end of the Revere Beach Reservation. Its entire length is 5.24 miles, of which .482 mile is in the city of Medford, 1.653 miles in the city of Everett, .814 mile in the city of Chelsea and 2.291 miles in the town of Revere. Early in the spring construction will have been completed from Main Street in Everett to Revere Beach, with the exception of a short section in Revere at the Winthrop Avenue crossing of the Boston & Maine Railroad. Takings and abandonments have been made this year between Mill Street and Campbell Avenue, in order to join with the railroad in constructing an overhead bridge for the highway and parkway combined at a point just south of the Revere Beach station on the main line of the Eastern Division. By these changes the original route along the shore of Snake Creek is abandoned from where it is crossed by the railroad, and the parkway runs parallel with Winthrop Avenue from the railroad crossing to Sales Creek. Some slight takings and abandonments have also been made during the progress of the work in arranging entrances for streets and facilitating settlements.

Mystic Valley Parkway.

This parkway extends from Weir Bridge at the foot of the lower Mystic Lake in Medford and Arlington to the western entrance of the Middlesex Fells. It first skirts along the

Mystic Lakes, its width in several places giving it a parklike character. It crosses the Aberjona River at its entrance into the upper Mystic Lake, and from that point includes both banks of the river up to the Winchester station at Manchester Field, a playground established in co-operation with the town and the Metropolitan Water and Sewerage Board. The remainder of the parkway is of a more conventional type, extending through Winchester up the steep slope of the hills to the boundary line of the Fells. The whole length of the parkway is 2.90 miles, of which 1.12 miles are in the city of Medford and 1.78 miles in the town of Winchester, and its construction is complete. A slight taking to discontinue the awkward entrance of Myrtle Street was made this year and some slight additional pieces of land have been acquired without additional cost in settlements with claimants.

West Roxbury Parkway.

Lands for this parkway to connect the Arnold Arboretum and the Boston Park System with the Stony Brook Reservation were acquired in 1894 under the original park act. Under an agreement with the city of Boston, which took land extending from the Arnold Arboretum to Weld Street in West Roxbury, the Commission made a taking of a strip of land from Weld Street to and including Bellevue Hill, and immediately transferred this land to the Park Commission of the city of Boston, by whom the parkway will be ultimately constructed. The total length of this parkway is 2.42 miles, of which 1.51 miles taken by this Commission lie wholly in that part of Boston known as West Roxbury.

Neponset River Parkway.

This parkway will continue to the Blue Hills the roadway already partly constructed through Stony Brook Reservation in continuation of the lines of the West Roxbury Parkway. Lands for the Neponset River Parkway have already been acquired from the southern end of the Stony Brook Reservation to Neponset River and along the river bank to Paul's Bridge, a distance of 1.12 miles. No construction has yet been undertaken, and the remaining link between Paul's

Bridge and Great Blue Hill has not yet been acquired. Of the portion already taken .72 mile is in the town of Hyde Park and .40 mile in the town of Milton.

Fresh Pond Parkway.

This parkway is the first section of a parkway intended to connect the takings on Charles River with those along the Mystic River, and thus with the Mystic Valley Parkway and the Fells. It is wholly in Cambridge, extending from Gerry's Landing back of the Cambridge Hospital to Fresh Pond. The portion which has been constructed is .52 mile long.

Furnace Brook Parkway.

This parkway is wholly in Quincy and is intended to furnish a connection between Quincy Shore and the Blue Hills. It is 2.54 miles in length, and no part of it has yet been constructed.

Nahant Beach Parkway.

This parkway, wholly in Nahant, extends from Oceanside at the Lynn line across Long Beach and along Little Nahant to the end of Short Beach. The entire length is 2.23 miles, and no construction has been undertaken. The taking for the greater part of the way extends across from the ocean shore to Lynn harbor, with the exception of the travelled highway in the centre, over which the town of Nahant still retains jurisdiction.

Lynnway.

This is the name adopted for the parkway which will extend from Revere Beach in the rear of the Point of Pines across the Saugus River to Lynn. It connects on the Lynn Shore with a State Highway. As the latter has not been constructed, no occasion has arisen for constructing the parkway and bridge. The total length of the parkway, including the bridge, will be .69 mile, of which .57 mile is in Revere and .12 mile in Lynn.

The following tables give the present areas of the reservations and lengths of the parkways: —

Reservations.

	Acres.
Blue Hills,	4,857.96
Middlesex Fells,*	1,882.95
Stony Brook,	463.72
Beaver Brook,	58.35
Hart's Hill,	23.09
Hemlock Gorge,	23.11
Charles River,	562.84
Mystic River,	289.44
Neponset River,	928.83
King's Beach and Lynn Shore,	10.81
Revere Beach,	67.34
Winthrop Shore,	16.74
Quincy Shore,	37.97
Nantasket Beach,	24.51
	9,247.66

Parkways.

	Miles.
Blue Hills,	2.280
Middlesex Fells,	4.605
Revere Beach,	5.240
Mystic Valley,	2.900
West Roxbury,	1.510
Neponset River,	1.120
Fresh Pond,	.520
Furnace Brook,	2.540
Nahant Beach,	2.230
Lynnway,	.690
	23.635

2. ADMINISTRATION.

The general offices and engineering department continue to be located in the Congregational Building, at 14 Beacon Street. The Commission has again been notified that no room is available at present for these purposes in the State House. The present situation, however, has proved convenient for the work of the Commission. The general form of administration remains substantially unchanged, the Secretary acting as the executive officer of the Commission, and the departments reporting through him to the Commission. The development and increasing use of the reservations and parkways has materially increased the amount of detail to be handled in the general office. This, however, has been com-

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* Not including 1,145.03 acres of Water Works Reservations under the care and control of this Commission.

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pensated for to some extent by the practical cessation in land takings, so that it has not been necessary to increase the office force. Owing to the progress made in settlement of land claims, it has also been possible to combine the departments of law and claims into one.

Landscape Architects.

The Commission still retain Messrs. Olmsted Brothers as landscape advisers, but the character and amount of the services required of them has naturally changed with the work of the Commission. Their opinions have been required on matters relating to works of construction, location of roads, forestry and plans for future development so far as required for meeting present problems. Their report, printed with this report, gives in detail the work they have been called upon to do.

Engineering Department.

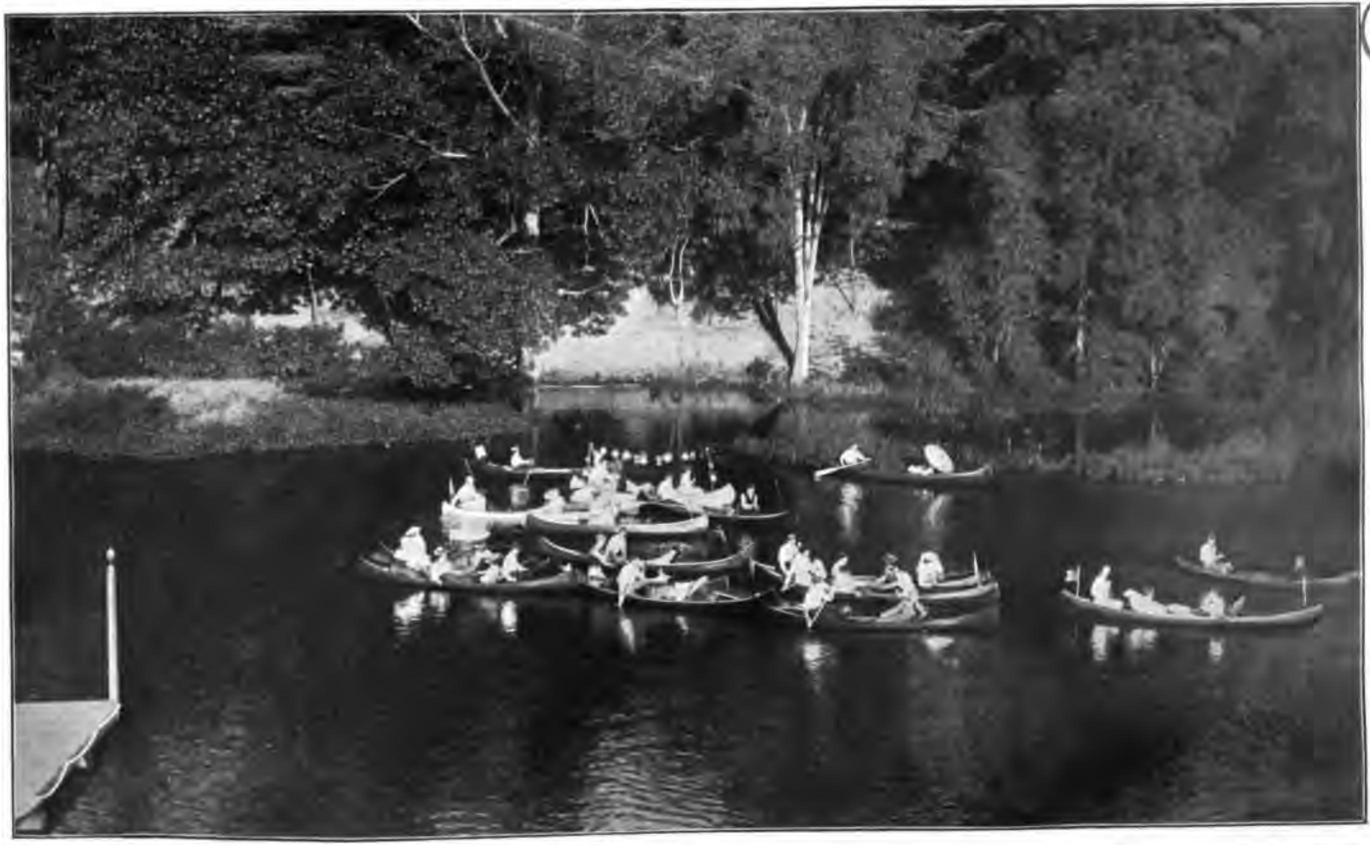
This department has been engaged this year in three important pieces of construction. The portion of the Revere Beach Parkway between Main Street in Everett and Campbell Avenue in Revere has been substantially completed, with the exception of the railroad bridge and approaches where it crosses the Boston & Maine Railroad near the Revere station. This work will be done in the spring by the railroad under the supervision of the Engineer of this Commission, in connection with the separation of the Winthrop Avenue grade crossing under a decree of the Superior Court. This delay, however, is not likely to interfere with the early opening of the parkway, which can be used at once in connection with the existing highway. Mattapan Bridge has been well started, and should be completed by the middle of the coming summer. A diagram and description of this bridge will be found in the report of the Engineer. This bridge not only furnishes an adequate connection between Blue Hill Avenue and the Blue Hills Parkway, but also provides a much-needed improvement in the approach to an important part of Milton. Work has also been begun this year under a special appropriation on a section of Charles River Road in Watertown between the United States Arsenal and Watertown

Square. This is the second section of road to be built according to the plan of the Landscape Architects, to provide in the takings, where practical, for a road upon one side of the river along the valley of the Charles in the District. The Engineer has also completed plans for Wellington Bridge and its approaches, which is to carry Fellsway and Middlesex Avenue across the Mystic River from Somerville into Medford. This bridge was authorized and a special appropriation of $200,000 made therefor by the Legislature of 1901. It will be a pile bridge, 1,145 feet long and 70 feet wide, containing a retractile draw with an opening of 50 feet. Manchester Field, the playground in Mystic Valley Parkway near the Winchester station, has been substantially completed. One roadway in Whitmore Brook Entrance from West Medford into the Fells has been built. Supervision has also been furnished by this department for minor work in the reservations and parkways, the particulars of which appear in the report of the Engineer.

Among the topographical surveys made this year are those of Nahant Beach, and portions of Charles River Reservation and the H. L. Pierce devise in the Blue Hills Reservation. Considerable progress has been made in preparing construction plans for parkways and boundary roads in advance of actual construction. This work is important, in order that owners of lands abutting on the park holdings may know as early as possible what will ultimately be the requirements of entrances, especially as to grade. The Engineering Department has also made at regular periods an inspection of the bridges for the care of which the Commission is responsible. The usual number of plans have been prepared, required in the trial of cases and settlement of claims. A considerable reduction was made in the force of this department in the early part of the year.

Law and Claims Department.

The trial of cases against the Commonwealth arising out of the work of the Commission is by law conducted by the Attorney-General's department; but the preparation of takings, deeds, contracts and other legal papers, the search of titles and general office business, is conducted by the law



CHARLES RIVER RESERVATION.—FLOAT DAY.

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department at the office of the Commission, in charge of attorneys approved by the Attorney-General. The negotiation of settlements with claimants and preparation of data for making of awards and assessments of betterments have also made it necessary to maintain a claim department, in charge of a competent attorney. The fact that no additional takings of importance have been made this year and that good progress has been made in the disposition of outstanding claims has made it possible this fall to combine these two departments into one, under the charge of George L. Rogers, Esq., who has Stanley M. Bolster, Esq., as his assistant. During the year 296 claims, amounting to $587,036.47, have been settled. Of these claims, 193 were for lands taken for reservations, amounting to $396,689.26; and 103 were for lands taken for parkways, amounting to $190,347.21. These claims were divided, by reservations, as follows: Charles River, 53; Winthrop Shore, 11; King's Beach, 1; Lynn Shore, 3; Stony Brook, 6; Mystic River, 33; Neponset River, 37; Middlesex Fells, 6; Quincy Shore, 6; Hart's Hill, 2; Revere Beach, 6; Nantasket Beach, 29. The parkway claims were divided as follows: Revere Beach, 45; Furnace Brook, 36; Mystic Valley, 4; Neponset River, 3; Middlesex Fells, 12; Blue Hills, 3. Of the total of 296 claims settled, suit was brought on 50, of which 11 were actually tried and a verdict obtained, the remaining 39 being settled before trial was reached; 246 claims were settled without suit. There are now outstanding unsettled claims to the number of 325, of which 218 are claims for lands taken for reservations and 107 for lands taken for parkways. Those for reservation lands are divided as follows: Hemlock Gorge, 1; Middlesex Fells, 1; Charles River, 64; Neponset River, 67; Mystic River, 51; Revere Beach, 3; Nantasket Beach, 6; Quincy Shore, 13; Winthrop Shore, 10; Lynn Shore, 2. Those for parkway lands are divided as follows: Revere Beach, 66; Middlesex Fells, 9; Neponset River, 3; Mystic Valley, 7; Fresh Pond, 3; Furnace Brook, 16; Nahant Beach, 3. Of the total of 325 claims outstanding, suits have been brought on 142 at the date of this report. It is not necessary to give in detail the work of this department, but a consideration of the number and amount of claims disposed of will indicate, to any one familiar with legal work, the importance of the work accomplished since the date of the last report.

Superintendence.

The Commission does not employ a general superintendent, but makes the local superintendents directly responsible, through the Secretary to the Commission, for the care and order of the lands in their charge. In several cases, however, reservations and parkways which can be conveniently grouped together are placed in the charge of a single superintendent. By this means it has been possible to provide supervision for additional reservations and parkways without increasing the number of superintendents. The increase in police work due to these additional acquirements has been provided for by appointing sergeants of police to assist the superintendents in police work.

The Secretary also has the assistance of the Supervisor of Construction, who visits the reservations and parkways, advising the superintendents as occasion requires, and taking special charge of any construction work of importance done by the forces employed by the Commission. The past year has seen a marked increase in the use of the park system, and the work of policing has been especially arduous during the summer months. The number of the regular police has been added to during the summer months for several years by temporary officers furnished through the Civil Service Commission, who rank as reserve officers and are laid off at the end of the season. During the winter months the Commission has, to such extent as it felt was economical, given those reserve officers desiring work positions in the laboring force of the reservations. Regular officers are also expected to take their turn at work in the reservations when there is no police work required. This method has been found to be of benefit both to the police and to the work of the Commission. Instead of periods of inactivity, which are distasteful to strong and vigorous men, such as police officers should be, the men are engaged in different employments as the occasion demands, mostly in the open air, and the Commission, on the other hand, has a body of men to use as police whenever needed, with whose characters and abilities they are more acquainted from year to year. The total police force employed during the summer was 81, which was reduced in October to 57. The order in the reservations has been excellent, and the number of arrests made remarkably small in proportion to the number of people visiting the reservations and using the parkways. For example, the whole number of arrests during the year at Revere Beach has been 90, and at Nantasket Beach 116. Nearly all these arrests were for minor offences. Considering the enormous crowds which the intense heat of last summer brought to these beaches, the small number of offences seems remarkable.

The Commission now employs seven superintendents, and their headquarters and work are divided as follows: —

Supt. Frank Dings, headquarters Hillside Street, Milton, Blue Hills Reservation, also has charge of Stony Brook, Neponset River and Quincy Shore reservations, and Blue Hills, Furnace Brook and Neponset River parkways; Supt. Charles P. Price, headquarters Pond Street, Stoneham, Middlesex Fells Reservation, also has charge of Mystic River Reservation and Middlesex Fells and Mystic Valley parkways; Supt. Herbert W. West, headquarters Revere Beach Reservation, also has charge of Winthrop Shore, King's Beach and Lynn Shore reservations and Revere Beach and Nahant Beach parkways; Supt. John L. Gilman, headquarters Speedway, Brighton, has charge of the lower part of the Charles River Reservation, extending from Cottage Farms to Moody Street Dam, Waltham, and of Fresh Pond Parkway in Cambridge; Supt. Albert N. Habberley, headquarters Weston Bridge, Auburndale, has charge of Riverside section, Charles River Reservation, from Moody Street Bridge to Newton Upper Falls, and Hemlock Gorge Reservation; Supt. Moody Leighton, headquarters Nantasket Beach, has charge of the reservation of that name; Supt. Robert Elder, headquarters Mill Street, Belmont, has charge of Beaver Brook Reservation. The details of the work in these reservations and parkways here follow: —

In the *Blue Hills Reservation* there has been the usual work incident to the care of the forest reservations, of caring for the roads and paths, cutting out of boundaries and fire guards, and in the spring and fall and during dry seasons of watching for fires and extinguishing them whenever they occur. No extensive or destructive fire has occurred this year, although several threatening ones have started. The immunity from fire in the Blue Hills has added much to the tree growth; but this advantage alone is not sufficient to replace the sprout and inferior growth with trees of a better and more suitable character. Each year the Commission has done something, with the limited funds available for this purpose, towards restoring the natural forest, which has disappeared by reason of the frequent fires and cuttings of a long series of years. This year the deciduous sprout growth has been removed from around pine seedlings in the valley between Hemenway and Hancock hills, at Breakneck Ledge and on the western slope of Chickatawbut. Similar work was done around Barberry Bush Spring. Undergrowth was also removed about the pines at Pine Tree Brook Entrance, encouraging the growth and making a better opportunity for picnicking. Some forestry work was also done south-west of Hoosicwhisick Pond. Eleven hundred seedlings from Wolcott Pines and Pine Tree Brook Entrance were replanted on the slopes of Hancock and Hemenway hills. Dead and fallen trees have been removed from the sides of the one administration road which runs through the centre of the reservation. Hillside Street within the reservation has been repaired and partly relocated. The special appropriation made last year for this purpose carried the work from the southern boundary to headquarters, and an equal amount is needed this year to complete the remaining portion of the street for which the Commonwealth is responsible to the public. Marigold Lodge, the shelter and lunch stand at Hoosicwhisick Pond, has been painted and otherwise improved, and was kept open by the lessee until the close of the season. The boats on the pond have been largely used, and the usual numbers have visited the top of Great Blue Hill. Hoosicwhisick Pond and Great Blue Hill are the best known and most visited points of interest, but a larger number is each year becoming acquainted with the other equally interesting features of the reservation, a part of the charm of which is their seclusion and less accessibility.

Blue Hills Parkway will not attain its full usefulness until construction shall have been continued from Canton Avenue into the reservation itself. Nevertheless, in connection with Harland and Hillside streets it already furnishes to the driving and riding public a direct means of approach from Mattapan Square to the centre of the reservation. The building of Mattapan Bridge, connecting the parkway with Blue Hill Avenue in Boston, has already been referred to. That portion of Harland Street within the boundaries of the parkway has been repaired and improved this year. Just beyond Canton Avenue, where the parkway broadens out to the width of the valley of Pine Tree Brook, a dam has been built which will provide a skating pond.

At *Quincy Shore*, where no construction has yet been done, nothing has been required beyond posting and clearing up of rubbish. In a portion of the lands taken on *Furnace Brook Parkway* a section of the high-level sewer of the Neponset System of the Metropolitan Sewerage System is being built, and the surplus material is being so deposited as to lessen the expense in building the road which will ultimately be built by this Commission.

Stony Brook Reservation calls for no special mention, as the work there has been only the routine work common to all the wooded reservations. Along the *Neponset River* considerable progress has been made in clearing up rubbish, and something done towards the preservation of the existing tree growth. A small amount of tree planting has also been done. Near Mattapan private land owners have been permitted to construct an extension of an existing private way, known as Edgewater Drive, over the reservation to River Street. This has rendered necessary the removal of several old buildings.

The regular work of the *Middlesex Fells Reservation* is of much the same character as that of the Blue Hills. There is, however, a much larger amount of travelled roads to care for, and this year good progress has been made towards putting both town and interior roads into good condition. The work of the Metropolitan Water Board about Spot Pond and Fells Reservoir, and consequent relocation of roads, is completed. Early this coming year the work on Bear Hill

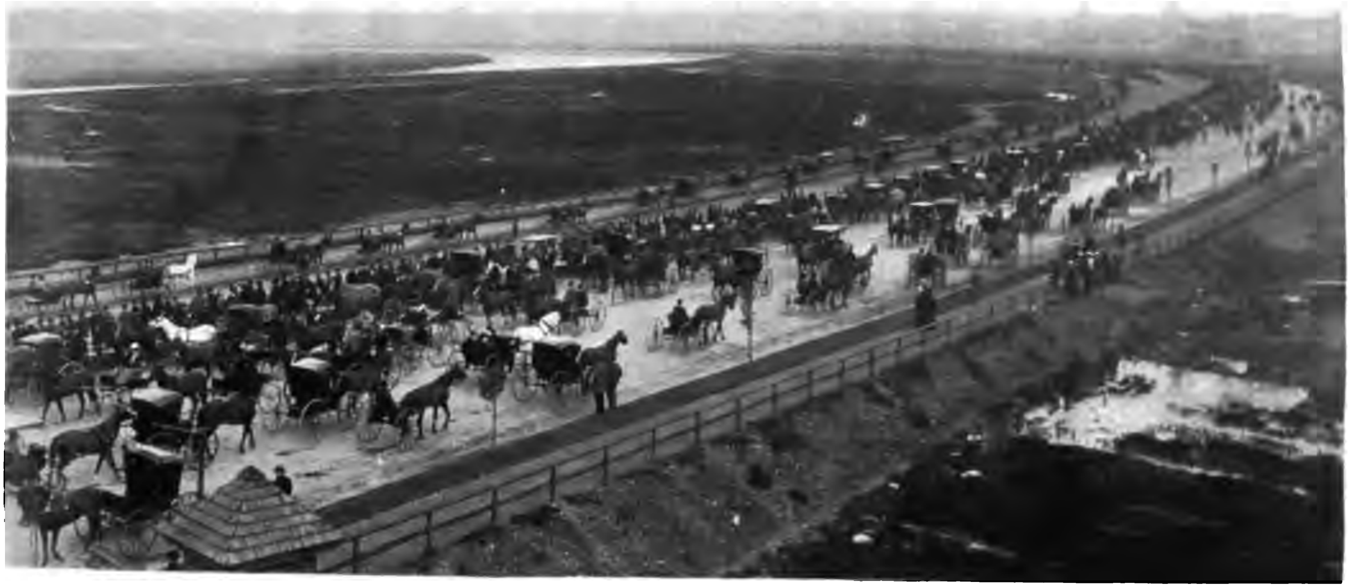
Reservoir will be finished and any unusual use of the roads thereafter is not anticipated. It should be possible, therefore, with a small appropriation, to have the existing roads, so far as surface is concerned, in good condition by next summer. It will not be many years, however, before the location of permanent roads in the Fells will have to be determined, and the Commission have made considerable progress in accumulating data for the proper consideration of this problem when it arises. Considerable time and labor have been expended in fighting the insect pests which have threatened the tree growth of this reservation. The cessation of the work of the Gypsy Moth Committee of the Board of Agriculture made it necessary for the Commission to fight the gypsy and brown-tail moths, which were present in large numbers in certain sections of the Fells. A number of laborers familiar with this kind of work have been employed at favorable seasons in destroying caterpillars, pupæ and egg-clusters. A record has been kept of the destruction of 44,534 egg-clusters, and much more useful work of this kind can be done at a later season. In this connection the Commission has to acknowledge receipt from the Board of Agriculture of a considerable quantity of tools, apparatus, furniture, etc., which was disposed of under a statute passed by the last Legislature. In the line of forestry, rescue work has been carried on along the Medford-Winchester border road, Quarry Road, Rifle Pond and in the Malden section. Some improvements in the shape of additional sheds, storage buildings, etc., have been made at headquarters, and a water supply has been provided through the courtesy of the Metropolitan Water and Sewerage Board.

The *Middlesex Fells Parkway* has required, like other parkways, policing, lighting, watering and repairs. The railroad bridge of the Medford Branch of the Boston & Maine Railroad has been replanked, and gutters have been built on the sides of the approaches to the bridge. The *Mystic Valley Parkway* contains many fine trees, and it has been necessary to remove from them the nests both of the gypsy and brown-tail moths. The near completion of Manchester Field, which is a part of the reservation, has already been mentioned. A drinking fountain has been located at a point near the Medford-Winchester line. No construction work has been undertaken in the *Mystic River Reservation*, but a number of old buildings have been removed and a little grading done near Cradock's bridge.

Beaver Brook Reservation is visited each year by an increasing number of people. It has been kept as nearly as possible without change, for its rural character is one of its greatest attractions. The Waverley oaks and other specimens of fine old trees have had special attention, and during the winter months the ponds have had considerable attention in order to make them safe and comfortable for skating. During the summer the electric car line has brought large numbers of picnickers, who make arrangement to reach this reservation from all parts of the district by special cars. Probably not less than one hundred and fifty thousand people have visited this reservation during the season. Every one is free to wander over the grass and through the shrubs and trees in every direction, but no instance of wilful damage has occurred. Considerable work, however, is required in keeping the reservation in good order during the picnicking season. Additional sanitary accommodations have been provided this year in the lower part of the reservation, and needed repairs have been made to the house occupied by the Superintendent. The course of Beaver Brook has been slightly changed in the reservation, to meet the improvements made by the widening of the street and changes in the culvert across Trapelo Road made by the town of Belmont and city of Waltham.

Hemlock Gorge Reservation and *Riverside Section of Charles River Reservation* have been administered together the past year. The border roads on the Newton side from Newton Upper Falls to Newton Lower Falls, which was practically completed last year, was put in shape and opened last spring. In several places trees and shrubs have been planted which in time will screen the view of buildings from the river. Several groves of trees which have suffered from previous neglect have been cleared of dead wood and other rubbish, and the growth encouraged. At Forest Grove a number of unsightly buildings have been removed. At Moody Street Bridge in Waltham the removal of old buildings has opened the view up the river. The site of these buildings has been graded over and planted, and necessary fences erected for the safety of the public and the protection of these lands. The city of Newton, under an arrangement with this Commission, authorized by an act of the last Legislature, is laying a sewer through the Hemlock Gorge Reservation. Every precaution is being taken to avoid injury to the reservation during the progress of the work. The floats at the canoe carries at Newton Upper Falls have been renewed. There has been an increase in the use of the river for pleasure boating. The boat houses have been unable to meet the increasing demand for lockers in the Riverside section. The usual police patrol has been maintained on the river. A good many accidents have occurred, due to carelessness and inexperience. Forty-two persons have been taken from the water by the police, but no fatality has occurred.

In the *Speedway Section of Charles River Reservation* the main part of the work has been confined to the Speedway itself. The surface of the Speedway has been kept in satisfactory condition, and its use by the driving public steadily increases. In June the driving clubs about Boston held a parade under regulations approved by the Commission. Unpropitious weather made two postponements necessary, but at last the parade took place on May 29. It was witnessed by a large number of people, and gave much pleasure. The dike has been repaired wherever settlements have shown themselves, and the upper road has been resurfaced where needed. Harvard College has completed its boat house at the lower end, and also the fence around Soldiers' Field. The lease of Heaton's Wharf, just opposite Soldiers' Field, expired April 1, and the unsightly buildings were at once removed. The cities of Cambridge and Boston, however, have not yet rebuilt the Boylston Street Bridge, which is generally admitted to be inadequate and unsafe. Above the Speedway something has been done towards improvement of the banks by removal of old buildings and rubbish. At



CHARLES RIVER RESERVATION.—The Speedway Parade.

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Watertown Square some of the buildings formerly occupied by the Walker-Pratt Company have been taken down. In *Fresh Pond Parkway* and *Lowell Memorial Park* planting has been carried out on the design furnished by the Landscape Architects, and a number of dead trees removed. The roadway and walk at Gerry's Landing in the rear of the Cambridge Hospital have also been put in better shape.

Revere Beach Reservation still continues to be the most extensively used of all the holdings of the Metropolitan Park System. The attendance this year has been greater than ever before, and has been materially increased by the building of several structures for popular entertainment of various kinds on private lands adjacent to the reservation. During the winter season the regular police and laboring force were occupied, under the direction of the Superintendent, in putting things in order for the summer season. All exposed work in the bath-house and shelters has been painted this year. Twelve new wells have been driven, to provide an added supply to the water system, which furnishes water for the use of the laundry, police station and bath-house, and for watering the driveway. All machinery has been thoroughly overhauled, and additional stand-pipes and hydrants installed for fire protection. As soon as the weather was favorable, the driveway and sidewalks from Beach Street to Revere Street were resurfaced, and considerable brick sidewalk was laid in front and in the rear of the bath-house. The old roadway between Revere Street and the Point of Pines has also been kept in repair.

The summer was an especially favorable one for bathing, and the total number of bathers who used the bath-house was 170,993. This number was divided by sexes as follows: males, 108,264; females, 62,729. The largest number on any day was on June 30, when 7,995 used the bath-house. Permits were issued to about 2,900 residents of Revere to cross the reservation in bathing costume. There were 5,770 bicycles checked in the bicycle room. The number of employees varied from 61 to 90. The usual life patrol was maintained, and made 20 rescues during the season. In the emergency room 141 cases were treated, and no fatality or serious accident occurred. The total receipts from the bath-house and bicycle room were $38,272.65. The expenses were as follows: —

Pay rolls,	$18,814 66
Bathing suits,	4,147 53
Stockings,	401 09
Towels,	510 50
Findings,	87 58
Coal,	656 29
Lighting,	1,671 14
Engine room and laundry,	288 39
Hardware,	180 40
Stationery,	16 75
Repairs,	44 78
Paint,	543 87
Tickets, etc.,	109 35
Medicines and attendance,	191 04
Lumber, etc.,	39 63
Supplies,	372 58
Boys' rooms,	959 21
Wells,	956 31
Shutters,	480 00
Stand-pipes and hose,	237 67
Furnishings,	204 06
Disinfectant,	78 86
Ice,	147 11
Uniforms,	32 55
Caps,	32 61
Sewing machine,	40 00
Electrical work,	48 85
Rubber rings,	41 13
Flags,	25 05
Brushes and combs,	21 00
Tide cards,	15 00
Clock,	5 50
Miscellaneous,	112 78
Total,	$31,513 27

The balance to the credit of the bath-house will be required for renewals, repairs and improvements. Work has already been begun in transforming the bicycle room into a general boys' bath-house. The room is fitted with benches, and each boy on receiving his bath suit will be assigned a locker, in which his clothing will be deposited during the bath. Instead of separate bath-houses, the room is divided by benches for use in undressing and dressing. There are 500 lockers in the boys' bath-house, and it will result in giving considerable relief to the main bath-house on crowded days. Additions are also being made to the public sanitaries connected with the bath-house. The usual good order in the reservation has been maintained, and the crowds have been handled without serious accident. For the entire year there were 90 arrests, of which 36 were for drunkenness and the remainder for minor offences; and during the summer season 203 lost children were taken care of and returned to their parents or friends. The summer carnival arranged by the residents of Revere was held from August 16 to September 7. Various popular amusements, parades and water sports were carried on each week day on the reservation by permission and under the regulations and rules of the Commission. Very large numbers visited the reservation during these two weeks, and only three arrests were found necessary.

The finished portion of *Revere Beach Parkway* extends from Charles Eliot Circle to Winthrop Avenue, and, with the exception of additional planting, has required nothing but general care. A tool house has been built near the Chelsea and Revere town line, for use on the opening of the remainder of the parkway in the spring.

The roadway in the *Winthrop Shore Reservation* has several times been covered with sand and stones during heavy storms. No harm has been done to the roadway, but portions of the outer promenade have been badly washed. It will be economical to give this walk an asphalt or granolithic covering, which will prevent further damage. Additional steps to the beach have been built at the northern end of the reservation, and the iron fence along the promenade has been painted.

King's Beach and *Lynn Shore Reservations* have been administered together. A temporary fence has been built along the property line, and, although no other improvements have been made except to clear the beach of rubbish and fill a few cellar holes, the beach has been used by large numbers of people. As the beach was before the taking private property, this was at first a source of some annoyance to abutting owners. It therefore became necessary to post the reservation and maintain a police patrol. The use of the beach by bathers who came considerable distances in bathing costume was considerably increased by the removal of the bath-houses from Nahant Beach.

The *Nahant* beaches were transferred to this Commission in November, 1900, and steps were immediately taken towards removal of the buildings at the Lynn end of the long beach in the early spring. The fact that many of these buildings were personal property of individuals led to some complications and delays, and it was the middle of July when all débris had been removed and the beach cleaned up. The Commission, by personal examination, satisfied itself that it was not desirable to retain the existing bath-houses or any of the other buildings even for use during last season. Their removal showed a condition of things that was unsanitary, and justified the course pursued. There is no question but what a large number of people felt the loss of the bathing facilities, insufficient as they have apparently been, and considerable numbers came in bathing costume from neighboring buildings. There is also an evident need for seats and benches, in addition to those provided by the city of Lynn in the adjoining Oceanside Park. The removal, however, of the group of buildings near the Lynn line which had been allowed to encroach upon the beach itself opened again the view along the curve of the beach, renewing the experience at Revere Beach, where the characteristic feature of shore scenery had also been for many years shut out by obstructing buildings. Although the highway across the beach is still under the jurisdiction of the town and its police, it was found necessary to police the beaches as well. The town and park police acted in co-operation with good results. Twenty-six arrests were made by the park police, nearly all of which were for statutory offences.

Nantasket Beach Reservation was used this year by a larger number of people than last year. The hotel and restaurant, roller coaster, merry-go-round, bathing and photograph privileges were leased for the summer, and were satisfactorily conducted under the rules and regulations of the Commission. All the buildings at the entrance to the steamboat wharf and railroad station except the block of

NANTASKET BEACH RESERVATION.—LABOR DAY.

UNIV. OF MICH.

three stores were taken down, and the premises cleared up and graded. A police station, which also includes the Superintendent's office, emergency room and men's sanitary, has been built at this point, and is in use. The strip of land between Nantasket Avenue and the railroad location will be used for administrative purposes. At the close of the summer season steps were taken towards carrying out contemplated improvements for the next season. The roller coaster will be located farther north, near the railroad crossing. It will be connected with the merry-go-round by a platform, and a similar walk has been constructed between the merry-go-round and the hotel piazzas. These piazzas and platforms will thus afford a public promenade or "board walk," 1,560 feet long, on the water side of all the buildings. The old bath-houses have been taken down, and plans are in preparation for a new bath-house, to be carried on by the Commission. It will probably be located on the beach to the south of the present buildings. Improvements have been made to the surface of Nantasket Avenue. It is desirable that curbing should be set along the edge of the sidewalks most used.

3. MISCELLANEOUS.

As a matter of convenience, there was printed as an Appendix to last year's report of this Commission the findings of the special commission appointed by the Supreme Judicial Court to apportion the expense of the Metropolitan reservations and parkways among the cities and towns of the Metropolitan Parks District and the Commonwealth. At that time the matter of the acceptance of their report was before the court, which subsequently recommitted the report to the special commission for further findings. The special commission thereupon filed a supplemental award, to which objections were filed by the town of Brookline. The whole matter was reserved for hearing by the full court, and is about to be heard at the date of this report. For convenience, the reservation and report are printed herewith as an Appendix.

By chapter 107 of the Resolves of the year 1901, the Metropolitan Park Commission was required to report to the Legislature of 1902 upon the desirability and feasibility of constructing and maintaining a public bath-house and sanitary station upon that part of the Metropolitan reservations known as Nahant Beach. This report has been prepared by the Commission, and will be presented to the Legislature, as required by the resolve. For convenience of reference, it will also be printed as an Appendix to this report.

4. FINANCES.

The following tables show in brief form the expenditures under the various park loans for the year ending Dec. 1, 1901: —

METROPOLITAN PARKS LOAN.

Blue Hills Reservation: —		
Land,	$1,230 00	
Miscellaneous,	6,371 42	
		$7,601 42
Middlesex Fells Reservation: —		
Land,	$2,367 00	
Miscellaneous,	2,974 33	
		5,341 33
Revere Beach Reservation: —		
Land,	$21,982 92	
Miscellaneous,	13,738 59	
		35,721 51
Stony Brook Reservation: —		
Land,	$1,192 50	
Miscellaneous,	339 62	
		1,532 12
Beaver Brook Reservation: —		
Miscellaneous,	$121 10	
		121 10
Hemlock Gorge Reservation: —		
Miscellaneous,	$172 07	
		172 07
Charles River Reservation: —		
Land,	$79,731 38	
Miscellaneous,	26,278 07	
		106,009 45
Neponset River Reservation: —		
Land,	$32,203 67	
Miscellaneous,	4,929 16	
		37,132 83
Mystic River Reservation: —		
Land,	$50,145 72	
Miscellaneous,	3,982 52	
		54,128 24

Lynn Shore Reservation: —		
Land,	$6,200 00	
Miscellaneous,	772 09	
		$6,972 09
Quincy Shore Reservation: —		
Land,	$13,429 00	
Miscellaneous,	498 08	
		13,927 08
Winthrop Shore Reservation: —		
Land,	$305 00	
Miscellaneous,	2,084 46	
		2,389 46
Hart's Hill Reservation: —		
Land,	$10,000 00	
Miscellaneous,	87 35	
		10,087 35
King's Beach Reservation: —		
Land,	$1,500 00	
Miscellaneous,	21 80	
		1,521 80
General expense,		6,604 83
		$289,262 68

METROPOLITAN PARKS LOAN, SERIES II.

Blue Hills Parkway: —		
Land,	$16,200 00	
Miscellaneous,	10,789 71	
		$26,989 71
Middlesex Fells Parkway: —		
Land,	$11,976 19	
Miscellaneous,	2,999 42	
		14,985 61
Mystic Valley Parkway: —		
Land,	$15,195 00	
Miscellaneous,	11,095 63	
		26,290 63
Revere Beach Parkway: —		
Land,	$101,169 68	
Miscellaneous,	138,544 78	
		239,714 46
Neponset River Parkway: —		
Land,	$6,575 41	
Miscellaneous,	648 54	
		7,223 95
Fresh Pond Parkway: —		
Land,	$12,000 00	
Miscellaneous,	888 40	
		12,888 40

Furnace Brook Parkway: —		
Land,	$42,704 39	
Miscellaneous,	4,294 35	
		$46,988 74
Nahant Beach Parkway: —		
Miscellaneous,	$1,170 78	
		1,170 78
Charles River Speedway: —		
Miscellaneous,	$315 78	
		315 78
Blue Hills Roads: —		
Miscellaneous,	$408 00	
		408 00
Middlesex Fells Roads: —		
Miscellaneous,	$13,224 97	
		13,224 97
Lynnway: —		
Miscellaneous,	$15 61	
		15 61
Middlesex Fells and Lynn Woods: —		
Miscellaneous,	$50 75	
		50 75
General expense,		4,717 18
		$394,984 57

NANTASKET BEACH LOAN.

Land,	$136,624 19	
Miscellaneous,	21,795 47	
		$158,419 66

The following tables show the total amount expended in each loan and the cost of each reservation and parkway to Dec. 1, 1901, and the amounts charged by the Auditor's department to meet the sinking fund and interest requirements to Jan. 1, 1900: —

METROPOLITAN PARKS LOAN.

Blue Hills Reservation: —		
Land,	$357,847 79	
Miscellaneous,	241,457 32	
		$599,305 11
Middlesex Fells Reservation: —		
Land,	$681,998 98	
Miscellaneous,	207,503 01	
		889,501 99
Revere Beach Reservation: —		
Land,	$1,139,761 21	
Miscellaneous,	577,794 21	
		1,717,555 42

Stony Brook Reservation: —		
Land,	$280,281 37	
Miscellaneous,	74,345 22	
		$354,626 59
Beaver Brook Reservation: —		
Land,	$29,819 29	
Miscellaneous,	19,782 95	
		49,602 24
Hemlock Gorge Reservation: —		
Land,	$53,254 00	
Miscellaneous,	14,573 40	
		67,827 40
Charles River Reservation: —		
Land,	$1,299,546 54	
Miscellaneous,	138,317 59	
		1,437,864 13
Neponset River Reservation: —		
Land,	$125,369 36	
Miscellaneous,	28,533 77	
		153,903 13
Mystic River Reservation: —		
Land,	$117,074 22	
Miscellaneous,	14,587 96	
		131,662 18
Lynn Shore Reservation: —		
Land,	$86,391 40	
Miscellaneous,	1,496 91	
		87,888 31
Quincy Shore Reservation: —		
Land,	$44,448 00	
Miscellaneous,	5,105 00	
		49,553 00
Winthrop Shore Reservation: —		
Land,	$20,309 00	
Miscellaneous,	158,955 12	
		179,264 12
Hart's Hill Reservation: —		
Land,	$10,000 00	
Miscellaneous,	103 95	
		10,103 95
King's Beach Reservation: —		
Land,	$23,847 21	
Miscellaneous,	1,180 93	
		25,028 14
West Roxbury Parkway: —		
Land,	$244,976 01	
Miscellaneous,	8,313 67	
		253,289 68
General expense,		127,458 93
		$6,134,434 32

Sinking fund requirement to 1896,	$18,980 18	
Care and maintenance to July 1, 1896,	85,813 46	
Care and maintenance July 1, 1896, to Jan. 1, 1897,	19,604 06	
Sinking fund assessment for 1897,	63,630 70	
Sinking fund assessment for 1898,	9,755 55	
Sinking fund assessment for 1899,	64,224 00	
Interest,	23,318 61	
		$290,326 56
Total charged to Dec. 1, 1901,		$6,424,760 88

METROPOLITAN PARKS LOAN, SERIES II.

Blue Hills Parkway: —		
Land,	$132,892 02	
Miscellaneous,	148,362 00	
		$281,254 02
Middlesex Fells Parkway: —		
Land,	$205,745 39	
Miscellaneous,	434,363 12	
		640,108 51
Mystic Valley Parkway: —		
Land,	$170,764 20	
Miscellaneous,	202,310 90	
		373,075 10
Revere Beach Parkway: —		
Land,	$283,689 23	
Miscellaneous,	405,277 30	
		688,966 53
Neponset River Parkway: —		
Land,	$31,154 26	
Miscellaneous,	5,293 48	
		36,447 74
Fresh Pond Parkway: —		
Land,	$35,053 21	
Miscellaneous,	21,733 62	
		56,786 83
Furnace Brook Parkway: —		
Land,	$43,748 39	
Miscellaneous,	5,914 37	
		49,662 76
Nahant Beach Parkway: —		
Miscellaneous,	$1,170 78	
		1,170 78
Charles River Speedway: —		
Miscellaneous,	$472,894 77	
		472,894 77
Blue Hills Roads: —		
Miscellaneous,	$6,122 41	
		6,122 41

Middlesex Fells Roads: —		
Miscellaneous,	$45,033 41	
		$45,033 41
Stony Brook Roads: —		
Miscellaneous,	$37,183 45	
		37,183 45
Lynnway: —		
Land,	$20,500 00	
Miscellaneous,	88 87	
		20,588 87
Middlesex Fells and Lynn Woods: —		
Miscellaneous,	$4,682 27	
		4,682 27
General expense,		75,154 72
		$2,789,132 17
Sinking fund requirement for 1896,	$3,650 03	
Sinking fund assessment for 1897,	14,057 10	
Sinking fund assessment for 1898,	3,765 08	
Sinking fund assessment for 1899,	15,396 00	
One-half interest,	22,327 68	
		59,195 89
Total charged to Dec. 1, 1901,		$2,848,328 06

NANTASKET BEACH LOAN.

Land,	$572,313 02	
Miscellaneous,	52,182 10	
Total charged to Dec. 1, 1901,		$624,495 12

The appropriations heretofore made are as follows: —

METROPOLITAN PARKS LOAN.

Original appropriation, chapter 407, Acts of 1893,	$1,000,000 00
First Revere Beach Act, chapter 483, Acts of 1894,	500,000 00
Charles River Act, chapter 509, Acts of 1894,	300,000 00
Second Revere Beach Act, chapter 305, Acts of 1895,	500,000 00
General appropriation, chapter 466, Acts of 1896,	1,000,000 00
General appropriation, chapter 464, Acts of 1897,	500,000 00
General appropriation, chapter 530, Acts of 1898,	1,000,000 00
Revere Beach Bath-house Act, chapter 142, Acts of 1899,	125,000 00
General appropriation, chapter 396, Acts of 1899,	300,000 00
Charles River Improvement Act, chapter 465, Acts of 1900,	50,000 00
Fuller's Wharf Act, chapter 467, Acts of 1900,	30,000 00
General appropriation, chapter 445, Acts of 1901,	450,000 00
Mystic River Bridge Act, chapter 492, Acts of 1901,	200,000 00
	$5,955,000 00

To provide for interest and sinking fund requirements to 1900, chapter 311, Acts of 1897,	$900,000 00
Total amount of loans,	$6,855,000 00
Amounts received from sales of buildings, receipts from bath-house, fines, etc.,	198,334 01
Total,	$7,053,334 01
Total of amounts charged to loans,	6,424,760 88
Balance remaining in hands of State Treasurer,	$628,573 13

METROPOLITAN PARKS LOAN, SERIES II.

Original boulevard, chapter 288, Acts of 1894,	$500,000 00
General appropriation, chapter 472, Acts of 1896,	500,000 00
General appropriation, chapter 521, Acts of 1897,	1,000,000 00
Saugus Bridge Acts, chapter 547, Acts of 1898,	100,000 00
General appropriation, chapter 428, Acts of 1899,	500,000 00
Mattapan Bridge Act, chapter 443, Acts of 1900,	75,000 00
Winchester Act, chapter 444, Acts of 1900,	50,000 00
Revere Beach Parkway Act, chapter 445, Acts of 1900,	200,000 00
	$2,925,000 00
To provide for interest and sinking fund requirements to 1900, chapter 311, Acts of 1897,	100,000 00
Total amount of loans,	$3,025,000 00
Receipts from sales, etc.,	29,907 41
Total,	$3,054,907 41
Amounts charged to loans,	2,848,328 06
Balance remaining in hands of State Treasurer,	$206,579 35

NANTASKET BEACH LOAN.

Appropriation, chapter 464, Acts of 1899,	$600,000 00
Appropriation, chapter 456, Acts of 1901,	100,000 00
	$700,000 00
Receipts from rents, etc.,	5,881 50
Total,	$705,881 50
Amounts charged to loans,	624,495 12
Balance remaining in hands of State Treasurer,	$81,386 38

Respectfully submitted,

JOHN WOODBURY,
Secretary.

DEC. 1, 1901.

LANDSCAPE ARCHITECTS' REPORT.

Hon. William B. de las Casas,
Chairman, Metropolitan Park Commission.

Dear Sir: — We beg to submit the following report for the year ending Nov. 30, 1901: —

Forest Reservations.

Partly on account of the petitions for street railway locations through the Blue Hills Reservation, touched upon in our last annual report, we were called upon to prepare preliminary plans for a system of future main roads in the western portion of the reservation, in order that any decision, whether positive or negative, that the Commission might be called upon to make in respect to railway locations along the borders of the reservation or elsewhere, might not interfere with probable future developments. The lines for about fourteen and one-half miles of main road were studied out with the assistance of the topographical map and by examination of the ground. These lines as studied, without substantial alteration, would provide adequately for passage through the eighteen hundred acres forming this part of the reservation and for rendering its most interesting points accessible; and this plan has already served its immediate purpose of helping to fix the proper location for tracks, whenever such location shall be granted, near the present western entrance of the reservation. But we have still to determine, by a more detailed survey and study, the precise lines and grades of these future roads, with a view to fixing them on the ground by permanent marks, so that the temporary paths and roads needed in the administration of the area and its gradual development may be made to follow as nearly as possible the permanent lines.

At the Stony Brook Reservation we have begun preliminary studies for a system for the conservative improvement and maintenance of the woods.

At the Middlesex Fells Reservation we have made similar studies in regard to the areas near Bear Hill and the Chandler Farm, and have guided the Superintendent in the delicate work of clearing some of the lands which have been growing up to a poor and scrubby sprout growth since the acquirement of the reservation. The project, which the Commission has under consideration, to pasture sheep on these lands for their permanent maintenance in grass, is a very wise one, as the fields will form a most agreeable contrast to the surrounding forest, and will be valuable for athletic sports.

River Reservations.

For the Charles River Reservation we have planned a canoe runway and the necessary landings and takings at Newton Lower Falls, and in connection with Messrs. Hartwell, Richardson & Driver a public boat house, proposed to be erected on the reservation at Moody Street, Waltham, by the proprietor of a former boat house at this point. We have directed the dredging of a shallow cove near the Auburndale Bridge, materially improving the boating conditions there; have consulted with the managers of the Riverside Recreation Grounds as to their improvements affecting the river and as to rearrangements of boundary and rights of way; and have made plans for an abandonment to the Waltham Canoe Club, to provide for an addition to their building. For the section between Galen Street and North Beacon Street, Watertown, a distance of one mile, we have made complete grading plans for a driveway and walk, and these plans are now being carried out under the direction of the Engineering Department. For the space between the driveway and the shore additional grading plans are now in course of preparation.

In consultation with the Engineer, we advised as to the work of constructing a trunk sewer of the city of Newton through the Hemlock Gorge Reservation. It was possible so to contrive the work as to do no serious damage to the picturesque landscape of this locality.

In connection with the Neponset River Reservation, the only matters calling for our attention during the year were an abandonment of land to the New York, New Haven & Hartford Railroad, to avoid undue interference with their projected improvements, and a proposed extension of Water Street, Hyde Park, across the river through the reservation to Milton Street. In regard to both of these objects we prepared plans after conference with those interested, and in the case of the latter made several alternative plans.

For the Mystic River Reservation we have prepared for the Engineer, as a basis for his estimates of construction, preliminary plans with grades, showing the principal constructive features that will be required in the improvement of the reservation.

BEACH RESERVATIONS.

Mainly as a basis for the guidance of the Commission in the work of needful temporary repairs and improvements at Nantasket Beach, we have made studies for a general plan for its ultimate improvement, and are proceeding to the completion of such a plan. Using these studies as a guide, we have advised the Commission and its architects, Messrs. Stickney & Austin, as to the location, grade and character of several small buildings, and as to the temporary improvement of their surroundings.

In pursuance of the act of Legislature calling upon the Commission for a report on a bath-house for Nahant Beach, we were called upon to consult with Messrs. Stickney & Austin in the preparation of a plan. We have submitted a preliminary plan for the location, approaches, surroundings and grades for such an establishment as seemed fitted to the probable needs of the locality, and the architects are now preparing the plans for the building.

PARKWAYS.

A revision of our previous plan for Balster Brook Parkway from Paul's Bridge to the Blue Hills was made in order to reduce the cost as to portions and to conform the lines to the wishes of those who had proposed to give land for the connection; and we took advantage of the opportunity to restudy and improve the design in other respects.

The construction of the Metropolitan Sewer through a portion of Furnace Brook Parkway called for advice from us as to its location and grade. A plan was made for an abandonment at Eaton's Pond, and new alternative plans were prepared for taking lines for the parkway east of Hancock Street and near Merrymount Park, Quincy.

The construction of Mattapan Bridge on the Blue Hill Parkway has called for some supervision by us, in order to insure a proper adjustment between the surroundings and the bridge; and the plans for the southern part of the same parkway were restudied in connection with the road plan for the Blue Hills Reservation.

On Fresh Pond Parkway, Mystic Valley Parkway and Revere Beach Parkway a considerable number of minor matters have required our attention during the year, in connection with maintenance, construction and planting.

As to the proposed new bridge across the Mystic River on the Middlesex Fells Parkway, we have been in consultation with the Engineer, and have prepared plans for the location of the bridge and the revision of the adjacent portions of the parkway and its junction with the Revere Beach Parkway and the Mystic River Reservation.

To sum up statistically, we have prepared during the year 54 studies, 36 preliminary general plans, 44 construction plans and sections, 8 architectural or engineering details and 17 planting plans, and have submitted 55 written reports.

Respectfully submitted,

OLMSTED BROTHERS.

DEC. 1, 1901.

ENGINEER'S REPORT.

Hon. William B. de las Casas,
Chairman, Metropolitan Park Commission.

Sir:—I herewith present my seventh annual report, enumerating the work of the Engineering Department for the year ending Nov. 1, 1901.

The force employed has been reduced at times during the year, following closely the requirements made upon the department. The number at the beginning of the year was 33, and at the end 22; average for the entire year, 30. The different classes of work have been in charge of the following division engineers:—

Construction,	John R. Rablin.
Surveying,	David A. Ambrose.
Drafting,	Louis V. Foster.

The total cost of conducting the department has been as follows:—

Services,	$25,845 88
Equipment,	98 52
Operating expenses,	1,847 36
Total,	$27,791 76

Construction and maintenance work, done under the supervision of the department, has amounted to $182,742.91.

An appraisal of the property in charge of the department, omitting the value of maps, plans, notes and records, is as follows:—

Equipment:—		
Offices,	$2,121 00	
Surveying and drawing instruments,	2,930 00	
Miscellaneous,	65 00	
		$5,116 00
Supplies:—		
General,		1,257 00
Total,		$6,373 00

There has been received during the year $139 from the sale and rent of surveying instruments, and repairs have amounted to $123.

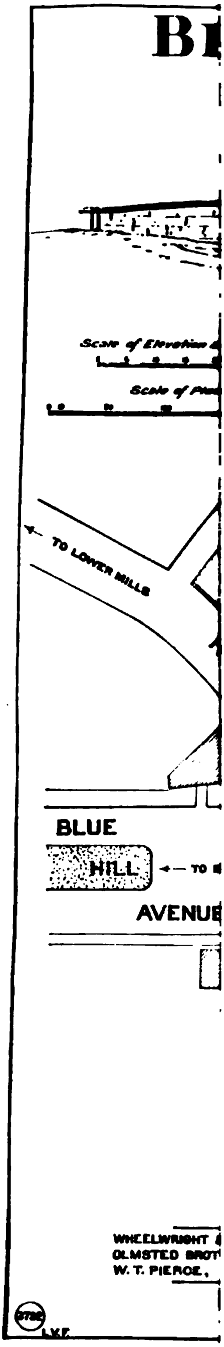
Details are given in the following parkway and reservation sections, and in the tables appended: —

PARKWAYS.

Balster Brook. — This parkway has been suggested as an alternative route for the Neponset River Parkway from Paul's Bridge to the Blue Hills Reservation. Additional topographical surveys have been made in connection with the studies of the Landscape Architects.

Blue Hills Parkway. — Preliminary arrangements for the new bridge across the Neponset River at Mattapan Square were completed early in the summer. These comprised the adoption of plans and completion of terms with the city of Boston, the New York, New Haven & Hartford Railroad Company and private owners, relative to takings in Mattapan Square and of lands for changes in the Mattapan railroad station grounds. The plans adopted provide for the extension of the parkway, of the full width of 130 feet, northerly, towards Boston, across the raceway to the proposed bridge. The total length of the bridge and curving wing walls will be 175 feet, with a clear width of 80 feet over the arches. There will be three arches for the river, one of 50-foot span and two of 14-foot span each. The raceway will be carried across the parkway through a culvert with an arch of 20-foot span. The entire masonry construction will be of concrete faced with granite, the arches reinforced with arched steel ribs on the system known as Melan construction. A circular drain, 6½ feet in diameter, built by the city of Boston, will have an outlet through the northerly abutment. The increase in area of opening over that of the present bridge will be 40 per cent., or, by excavating under the 14-foot relief arch, 53 per cent. The present bridge has a clear roadway of 22 feet; the new one will have 56 feet. The present walks are each 6½ feet; the new ones, 12 feet.

Proposals for construction were received May 13, 1901,


B
Scale of Elevation
Scale of Pla
TO LOWER MILLS
BLUE
HILL
TO
AVENUE
WHEELWRIGHT
OLMSTED BROT
W. T. PIERCE,
L.V.F.

on specifications for the Melan system, but allowing the submission of proposals on other systems, from the following: —

Melan system: —	
National Contracting Company, New York,	$52,505 00
Patrick McGovern, Boston,	47,744 50
Taylor, Carr & Andrews, Boston,	46,576 40
O'Hern & Berrigan, Rumford Falls, Me.,	44,300 00
Thacher system: —	
O'Hern & Berrigan, Rumford Falls, Me,	45,900 00
Ransome system: —	
Patrick McGovern, Boston,	45,494 50

The contract, No. 53, was awarded, June 12, to O'Hern & Berrigan for the Melan system. Work began July 17, 1901, and will be completed early in the summer of 1902. The contract was transferred by the contractors, with the consent of the Commission, Sept. 18, 1901, to H. A. Hanscom Company of Boston. The total estimated cost, according to vouchers of this department, to Nov. 1, 1901, has been as follows: —

Construction, including royalty,	$6,458 60
Incidental expenses,	71 05
Engineering and inspection,	1,066 55
Total,	$7,596 20

Repairs, costing $388.50, were made to the old bridge across the Neponset River before its care and maintenance were transferred to the contractors. The New York, New Haven & Hartford Railroad Company began July 9, 1901, on the new station grounds.

The Metropolitan Water and Sewerage Board has built a sewer across the parkway at Brook Road under a satisfactory arrangement with the Commission. Construction plans are being made from Canton Avenue to the Harland Street Entrance of the Blue Hills Reservation.

Fresh Pond. — A brick walk has been laid on Brattle Street, crossing the parkway. A short length of drain has been built to conduct water away from a spring. After the winter some repairs were made to the roadway surface, the contractor for the parkway, by agreement, doing part of the work.

Furnace Brook. — A taking plan has been made for an extension from Newport Avenue to Hancock Street, and construction plans completed. A topographical survey has been made for studies between Hancock Street and the Quincy Shore Reservation.

The line of the high-level sewer has been designed by the Metropolitan Water and Sewerage Board to be built in a portion of the section between Newport Avenue and Adams Street, for a distance of 2,400 feet. The location and manner of doing the work have been approved. The surplus from the trench is to be placed on location of proposed parkway drive.

Middlesex Fells Parkway. — Drainage improvements were made in March, 1901, on Fellsway West, at the corner of Fulton Street, Medford. An entrance to Fellsway East for a street on the Dexter estate, Malden, was made between April 15 and April 30, 1901. Incidental to this work were some changes in drains, made necessary to remove an outlet from private land. The total cost, including engineering, inspection and incidental expenses, was $731.31.

Plans are being prepared for a new pile bridge, to connect the Somerville and Medford sections of Fellsway, and to replace the old Wellington Bridge.

In October of this year the bridge over the Medford Branch Railroad was resheathed with 3-inch kyanized spruce under direction of the Superintendent.

Mystic Valley. — The work of grading Manchester Field, in Winchester, noted in my last report as begun Oct. 18, 1900, was continued, under contract No. 52, until Dec. 15, 1900; was resumed May 25, 1901, by day work, under direction of the Superintendent, and finished July 15, 1901. The total cost to date, omitting labor under direction of the Superintendent, but including, in item for engineering, cost of all services rendered by this department, has been as follows: —

Labor and tools, Contract No. 52, ...	$6,042 30
Furnishing of loam, ...	5,726 78
Incidentals, ...	115 36
Engineering and inspection, ...	734 80
Total, ...	$12,619 24

Proposals were received Oct. 3, 1901, for building a wooden foot bridge, 140 feet long and 8 feet wide, across the Aberjona River and an island at the southerly end of Manchester Field. The lowest proposition, that of J. J. Flynn, for $1,190, was accepted. This work is in progress, and is to be finished this year. Changes in gutter and edgestone at the corner of the northern extension of the parkway and Walnut Street were finished Nov. 23, 1900, at a cost of $70.70. The town of Winchester has constructed a sewer, between Lloyd Street and Cutting Street, under a license from the Commission.

Nahant Beach. — A topographical survey of this parkway, including levels on beaches, has been made over an area of 202 acres.

Revere Beach Parkway. — This parkway is well advanced towards completion for a distance of 4.17 miles, from the Charles Eliot Circle, of the Revere Beach Reservation, across Revere and Chelsea, to Main Street, Everett, except for about 1,000 feet at the crossing of the Eastern Division of the Boston & Maine Railroad at the Revere station. This crossing of the railroad is to be made in connection with the elimination of the grade crossing of Winthrop Avenue. The work is expected to be done in 1902.

Proposals were received April 22, 1901, for surfacing and other work, from Mill Street to Washington Avenue, and from Everett Avenue to Main Street, from the following: —

National Contracting Company, New York,	$240,210 25
Jones & Meehan, Boston,	179,074 25
The C. H. Eglee Company, Boston,	157,485 40
Patrick McGovern, Boston,	116,987 10
A. J. Wellington, Boston,	114,706 50
Coleman Brothers, Charlestown,	113,106 50

The contract, No. 54, was awarded to Coleman Brothers. Work began April 30, 1901, and is still in progress. To this contract has been added the construction of the portion between Washington Avenue and Everett Avenue, making the aggregate bid $124,849. The estimated value of work performed under this contract to Nov. 1, 1901, was $105,454.55.

Proposals were received May 20, 1901, for building from the junction of the parkway with Winthrop Avenue to Mill Street, from the following, omitting the crossing of the railroad at Revere station : —

Patrick McGovern, Boston,	$55,785 75
A. J. Wellington, Boston,	54,433 75
The C. H. Eglee Company, Boston,	52,351 75
Rowe & Hall, Boston,	51,707 50
Richard Falvey, Somerville,	48,985 25
John H. McCusker, Waltham,	44,687 25
Coleman Brothers, Charlestown,	44,022 00
McCarthy & Gill, Somerville,	41,973 00

This contract, No. 55, was awarded to McCarthy & Gill. Work began June 3, 1901, and is still in progress. The estimated value of work performed under this contract to Nov. 1, 1901, was $31,324.02.

These two contracts will be completed early in the spring of 1902. The total cost of construction and maintenance on the whole parkway, according to vouchers of this department, has been as follows : —

Previously reported : —		
Construction,	$239,568 51	
Engineering and inspection,	12,467 53	
		$252,036 04
Year ending Nov. 1, 1901 : —		
Construction,	$139,325 39	
Incidentals,	321 51	
Engineering and inspection,	4,581 99	
		144,228 89
Total,		$396,264 93

The crossing of Everett Avenue by the parkway necessitates the raising of the grade of the street 4 feet in Chelsea and Everett. An arrangement has been made for this work to be done by the two cities, and paid for from the funds for the parkway. The city of Everett has built a large drain in the parkway, between Second Street and Everett Avenue, with an outlet into tidal water. A portion of the cost of this drain is to be paid for from the parkway appropriation, as it provides for parkway drainage for a distance of 5,000 feet from County Road to Gladstone Street. The Metropolitan Water and Sewerage Board has constructed a sewer crossing the parkway in Chelsea near the Revere boundary. The Revere Water Company, under license from the Commission, has laid a 6-inch water main for a distance of 715 feet, between Pratt's Court and Stowers Street. The city of Chelsea has laid water pipes and sewers in the parkway, between Bassett Street and Orange Street. A system of sewers, prepared by the city engineer, for that portion of parkway under construction in Everett, has been approved, and in conformity therewith the city has built a sewer on the northerly side from Spring Street to Ferry Street.

Three proposals were received Oct. 25, 1901, for reflooring the Beachmont Bridge, over the Boston, Revere Beach & Lynn Railroad; and the lowest, that of Joseph Ross, $655.20, was accepted. This work has been finished, and consisted in replacing the two courses of oak planking with hard-pine plank in the deck, and spruce in the sheathing, course.

The completion of construction plans from Main Street, Everett, to Middlesex Fells Parkway and the Mystic River Reservation, Medford, a distance of about a mile, await the adoption of details of laying out.

RESERVATIONS.

Beaver Brook. — Trapelo Road in Waltham has been built to its full width of 49½ feet by the Concord & Boston Street Railway Company, under the conditions of their franchise from the city. A retaining wall has been built along the reservation and tracks laid close to the northerly line of the street, and the railway is in operation down to the Belmont town line.

Blue Hills Reservation. — A topographical survey has been made of 85 acres in the Henry L. Pierce devise, leaving about 615 acres still to be surveyed. Construction plans are being prepared for the Harland Street Entrance, as an extension of the Blue Hills Parkway. The main drive in this entrance, from the terminus of the parkway, will be .72 of a mile long, and the boundary road on the westerly side .81 of a mile long.

Charles River. — The boundary road from Washington Street, Newton Lower Falls, to Boylston Street and Hemlock Gorge Reservation, Newton Upper Falls, has been finished by Walter Chesley under Contract No. 51. The cost, including engineering and inspection, was $2,488.08. This is a narrow road of the simplest construction, is 1.78 miles long, and forms a ready means of access to this section and a valuable connection between Newton Lower Falls and Newton Upper Falls and the Hemlock Gorge Reservation.

Proposals were received July 15, 1901, for building the Charles River Road in Watertown, from North Beacon Street to Riverside Street, ranging from $56,748.70 to $100,082.50. The amount available for construction being insufficient, according to the canvass, all bids were rejected. The principal item of cost was the large expense of obtaining filling material by the proposed plans for dredging and improving the bed of the river. A modification of the plans resulted in the submission to the Commission of the following proposals, Aug. 7, 1901: —

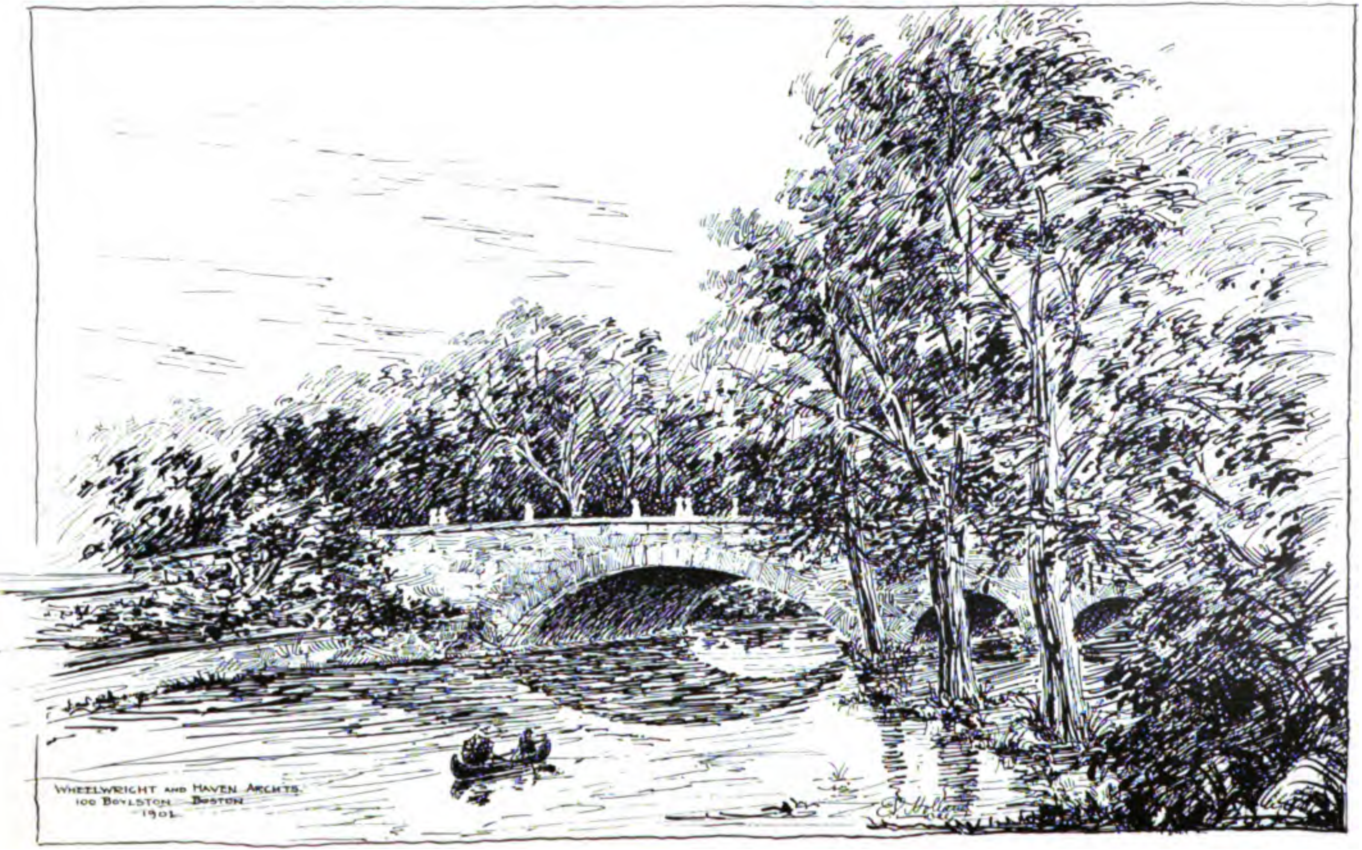
Nawn & Brock, Boston,	$55,571 50
T. Stuart & Son, Newton,	50,747 40
Jeremiah Sullivan, Cambridge,	49,633 40
Coleman Brothers, Charlestown,	49,249 50

The contract, No. 56–A, was awarded to Coleman Brothers, with reservations allowing such modifications as will keep the total cost within the limits of the appropriation. The work began Aug. 17, 1901, and is still in progress. The length of the road will be .97 of a mile.

The total estimated value of work done under this contract to Nov. 1, 1901, has been as follows: —

Construction,	$11,634 00
Incidentals,	60 25
Engineering and inspection,	427 15
Total,	$12,121 40

The city of Boston is constructing an extension of Brooks Street across the Charles River Reservation from Faneuil station to North Beacon Street. This is on a right of way



BLUE HILLS PARKWAY.—MATTAPAN BRIDGE.

UNIV. OF MICH.

granted the city by the Commission, with certain stipulations as to manner of construction. The marsh area between Brooks Street, Boston & Albany Railroad and North Beacon Street has been partially regraded with surplus earth from the street work, at a small expense for the spreading.

A topographical survey, over an area of 150 acres, has been made of the sections of the reservation along the lower portions of the river shores. Plans have been made for a proposed canoe-way at Cordingly Mills, Newton Lower Falls. Loam left over from the construction of Fresh Pond Parkway, to the amount of 1,365 cubic yards and at an expense of $556.25, has been carted to the Speedway.

Hemlock Gorge. — A sewer is being built by the city of Newton through this reservation, from Boylston Street to Elliot Street, as an extension of the city's system. This work is being done under a permit from the Commission, and, although the sewer extends the entire length of the reservation, the work is being carefully done without marring any of the natural beauties of the region.

Lynn Shore. — Some slight repairs have been made to the wooden bulkheads protecting the shore; but they are nearly all past repairing, and broken away, and the ocean is making serious inroads into the high bank which extends the entire length of the reservation. Construction plans for the treatment of this shore front have been prepared.

Middlesex Fells Reservation. — The boundary road leading to the reservation from Winthrop Street, Medford, along the easterly side of the Whitmore Brook Entrance, was finished, under contract No. 50–A, June 30, 1901. This road is .81 of a mile long, 20 feet in width, and finished with a gravel surface. Its comparatively large cost has been due to the nature of the country in which it has been built. The total cost of construction, according to vouchers of this department, has been as follows: —

Construction, ...	$10,147 17
Incidentals, ...	134 97
Engineering and inspection, ...	2,170 57
Total, ...	$12,452 71

The reservoir on Bear Hill, with connecting pipe lines, has been under construction by the Metropolitan Water and Sewerage Board.

Nantasket Beach. — Lines and grades have been given at various times for some grading and building improvements.

Neponset River Reservation. — The entrance to Edgewater Drive, from River Street, near Mattapan Square, has been roughly graded across reservation land by private parties, under permit from the Commission.

Quincy Shore. — Preliminary steps have been taken towards arranging for a plan of a proposed bridge over the railroad at Atlantic Street in Quincy.

Revere Beach Reservation. — A topographical survey has been made of the shore between Revere Beach and Winthrop Beach, over an area of 141 acres. This survey has been made in such manner that changes in the conformation of the shore and beaches can be determined.

Winthrop Shore. — The winter storms have several times washed sand and gravel on to portions of the Winthrop Shore Drive, but without injury to the roadway surfacing. The surfacing material has been washed out on portions of the promenade. It would be advisable to have the promenade surfaced with a material which will resist the wash and protect the backing of the sea wall.

Wooden steps, with landing placed on iron brackets, have been built down to the beach from the high wall near the bridge over the railroad. These were completed June 18, 1901, and cost $137. The fence on sea wall is especially subject to rusting, and in October, 1901, was given two coats of paint, under direction of the Superintendent. An entrance to the drive has been built by the town for Forrest Street.

Adjoining the southerly end of Winthrop Shore Reservation is Great Head, a high cliff, 95 feet above mean high water and composed of coarse drift. This department made a topographical survey of this headland in 1900. The second report of United States Commissioners on the condition of Boston harbor, made in 1860, mentions that the upper edge of this bluff seems to have been washed away 65 feet since the survey of 1847. Comparing the survey made for this report of 1860 and our survey of 1900, we find there has been a further wearing away of 50 feet.

GENERAL.

Topographical surveys have been made during the year of 660 acres. The total area represented by taking plans and plans of conveyance to the Park System, irrespective of action taken thereon by the Commission, is 40 acres; and by abandonment plans, 36 acres. Boundaries have been permanently marked by 234 stone bounds, iron bolts and drill holes in ledges. Engineering and inspection incidental to actual construction and maintenance, omitting travelling and other incidental expenses, has averaged 5.35 per cent.

The following tables are appended to this report: —

Table 1. Lengths of parkways.
Table 2. Summary of plan work.
Table 3. Summary of vouchers.
Table 4. Summary of cost of engineering.
Table 5. Prices for items of construction.

Respectfully submitted,

WM. T. PIERCE,
Engineer.

DEC. 1, 1901.

TABLE 1. — *Length of Parkways, corrected to Dec. 1, 1901.*

DESCRIPTION.	Construction completed (Miles).	Under Construction (Miles).	Remainder (Miles).	Totals (Miles).
Blue Hills: Mattapan Square to Harland Street Entrance of Blue Hills Reservation, Boston and Milton, ...	1.47	.08	.73	2.28
Fresh Pond: Mount Auburn Street to Huron Avenue, Cambridge, .	.52	–	–	.52
Furnace Brook: Hancock Street to Blue Hills Reservation, Quincy, .	–	–	2.54	2.54
Lynnway: Revere Beach Reservation to northerly side of Saugus River, Revere and Lynn, . .	–	–	.69	.69
Middlesex Fells: Broadway to Middlesex Fells, Somerville, Medford and Malden, ...	4.32	–	.28	4.60
Mystic Valley: High Street to Middlesex Fells Reservation, Medford and Winchester, ...	2.90	–	–	2.90
Nahant Beach: Lynn line at Washington Street to Spring Road, Nahant, ...	–	–	2.23	2.23
Neponset River: junction of River Street and Damon Street to Milton Street, Hyde Park and Milton, .	–	–	1.12	1.12
Revere Beach: Revere Beach Reservation to Middlesex Fells Parkway and Mystic River Reservation, Revere, Chelsea, Everett and Medford, ...	.36	3.81	1.07	5.24
Totals, ...	9.57	3.89	8.66	22.12

TABLE 2. — *Summary of Maps and Plans prepared during Year ending Nov. 1, 1901, omitting Blue and Other Prints.*

	Abandonments and Conveyances.	Construction.	Copies.	Entrances.	General.	Land and Settlement.	Restriction.	Takings, including Conveyances to Commonwealth.	Topographical.	Working Plans (Office).	Totals.
Parkways.											
Balster Brook,	-	-	-	-	-	-	-	-	1	-	1
Blue Hills,	1	23	4	-	2	3	-	1	3	33	70
Fresh Pond,	-	-	-	-	1	2	-	-	-	-	3
Furnace Brook,	8	23	3	-	-	4	-	4	1	23	66
Lynn Fells,	-	-	-	-	1	-	-	-	-	-	1
Middlesex Fells,	-	2	6	1	2	-	3	4	1	2	21
Mystic Valley,	2	3	1	-	2	6	-	3	-	12	29
Nahant Beach,	-	-	-	-	-	3	-	-	4	-	7
Neponset River,	5	-	-	-	-	-	-	1	-	1	7
Revere Beach,	17	38	3	4	3	23	1	9	-	47	145
Totals,	33	89	17	5	11	41	4	22	10	118	350
Reservations.											
Beaver Brook,	-	1	-	-	-	-	-	-	-	-	1
Blue Hills,	-	1	1	1	1	-	-	-	1	3	8
Charles River,	2	18	14	-	5	14	4	5	3	30	95
King's Beach,	-	-	-	-	1	-	-	-	-	-	1
Lynn Shore,	1	3	-	1	1	2	-	-	-	7	15
Middlesex Fells,	-	2	1	2	-	1	-	2	-	10	18
Mystic River,	2	-	1	-	-	14	-	-	-	2	19
Nantasket Beach,	-	-	-	-	3	3	-	-	1	3	10
Neponset River,	6	1	-	-	-	24	-	-	1	4	36
Quincy Shore,	2	-	2	-	1	4	-	-	-	-	9
Revere Beach,	-	2	3	-	2	-	-	-	-	1	8
Stony Brook,	2	-	-	-	-	-	-	-	-	-	2
Winthrop Shore,	1	-	-	-	14	6	-	-	-	2	23
Totals,	16	28	22	4	28	68	4	7	6	62	245
Grand totals,	49	117	39	9	39	109	8	29	16	180	595

TABLE 3. — *Summary of Vouchers of the Engineering Department, including, under Construction and Maintenance, the Entire Estimated Value of Work performed during Year ending Nov. 1, 1901.*

	Construction and Maintenance.	Boundaries, Monuments, etc.	Totals.	INCIDENTAL TO ENGINEERING DEPARTMENT.									Grand Totals.
				EQUIPMENT.		OPERATING EXPENSES.							
				Offices.	Surveying and Drawing Instruments.	Engineering and Surveying.	Offices.	Repairs.	Supplies.	Travel.	Incidental Expenses.	Totals.	
General equipment,	-	-	-	$51 61	$46 91	-	-	-	-	-	-	$98 52	$98 52
General operating expenses,	-	-	-	-	-	$720 00	$157 25	$138 29	$343 12	-	-	1,358 66	1,358 66
Parkways.													
Balster Brook,	-	-	-	-	-	75 10	-	-	-	-	$0 15	75 25	75 25
Blue Hills,	$6,863 10	-	$6,863 10	-	-	2,873 34	16 23	-	-	$68 00	50 24	3,007 81	9,870 91
Blue Hills roads,	-	-	-	-	-	407 70	-	-	-	21 00	30	429 00	429 00
Dedham,	-	-	-	-	-	2 44	-	-	-	-	-	2 44	2 44
Fresh Pond,	821 68	-	821 68	-	-	253 05	-	-	-	-	6 50	259 55	1,081 23
Furnace Brook,	-	$486 78	486 78	-	-	2,108 69	-	-	7 40	81 00	7 34	2,204 43	2,691 21
Lynn Fells,	-	-	-	-	-	50 75	-	-	-	-	-	50 75	50 75
Lynnway,	-	-	-	-	-	15 61	-	-	-	-	-	15 61	15 61
Middlesex Fells,	609 66	-	609 66	-	-	761 66	-	-	-	-	7 64	769 30	1,378 96
Middlesex Fells roads,	9,826 17	-	9,826 17	-	-	1,972 05	12 94	-	17 83	32 30	50 73	2,085 85	11,912 02
Mystic Valley,	11,501 83	-	11,501 83	-	-	1,120 82	-	-	9 77	68 60	10 05	1,209 24	12,711 07
Nahant Beach,	-	84 80	84 80	-	-	301 85	-	-	4 25	36 00	8 90	351 00	435 80
Neponset River,	-	-	-	-	-	201 56	-	-	-	-	1 30	202 86	202 86
Revere Beach,	139,325 39	52 18	139,377 57	-	-	6,978 09	-	-	131 90	28 28	183 43	7,321 70	146,699 27
Speedway (Charles River),	358 27	-	358 27	-	-	53 91	-	-	3 75	-	1 00	58 66	416 93
Parkway totals,	$169,306 10	$623 76	$169,929 86	-	-	$17,176 62	$29 17	-	$174 90	$335 18	$327 58	$18,043 45	$187,973 31

Reservations.													
Beaver Brook, ...	-	-	-	-	-	$98 90	-	-	-	-	$6 20	$105 10	$105 10
Blue Hills, ...	-	-	-	-	-	432 22	-	-	-	$18 00	4 18	454 40	454 40
Charles River, . . .	$13,299 56	$8 90	$13,308 46	-	-	3,298 90	$15 34	-	$27 31	27 78	44 48	3,413 81	16,722 27
Hemlock Gorge, . . .	-	-	-	-	-	106 78	-	-	-	16 50	5 54	128 82	128 82
King's Beach, ...	-	-	-	-	-	21 80	-	-	-	-	-	21 80	21 80
Lynn Shore, ...	-	-	-	-	-	486 84	-	-	-	-	3 25	490 09	490 09
Middlesex Fells, . . .	-	-	-	-	-	163 94	-	-	-	47 00	3 42	214 36	214 36
Mystic River, ...	-	-	-	-	-	443 10	-	-	-	-	10 45	453 55	453 55
Nantasket Beach, . . .	-	-	-	-	-	335 91	-	-	-	13 50	8 35	357 76	357 76
Neponset River, . . .	-	-	-	-	-	1,073 32	-	-	-	22 00	11 12	1,106 44	1,106 44
Quincy Shore, . . .	-	-	-	-	-	257 58	-	-	-	27 00	2 30	286 88	286 88
Revere Beach, . . .	-	-	-	-	-	692 69	-	-	-	5 00	8 45	706 14	706 14
Stony Brook, ...	-	-	-	-	-	70 14	-	-	-	-	60	70 74	70 74
Winthrop Shore, . . .	137 25	-	137 25	-	-	465 14	-	-	-	5 00	11 10	481 24	618 49
Reservation totals, . .	$13,436 81	$8 90	$13,445 71	-	-	$7,949 26	$15 34	-	$27 31	$181 78	$117 44	$8,291 18	$21,736 84
Grand totals, . . .	$182,742 91	$632 66	$183,375 57	$51 61	$46 91	$25,846 88	$201 76	$138 29	$545 33	$516 96	$445 02	$27,791 76	$211,167 33

TABLE 4. — *Summary of Engineering and Surveying.*

	Abandonments and Conveyances.	Boundaries, Plans, Staking and Monuments.	Construction and Maintenance, Incidental to Actual.	Construction, Preliminary to.	General.	Land and Settlements, Surveys and Plans.	Restrictions, Surveys and Plans.	Takings.	Topographical.	Totals.
Parkways.										
Balster Brook,	-	-	-	-	-	-	-	-	$75 10	$75 10
Blue Hills,	$13 73	$4 70	$1,229 40	$1,360 45	$20 37	$32 10	-	$156 27	56 32	2,873 34
Blue Hills Roads,	-	-	-	407 70	-	-	-	-	-	407 70
Dedham,	-	-	-	-	2 44	-	-	-	-	2 44
Fresh Pond,	-	26 60	190 30	17 20	2 45	16 50	-	-	-	253 05
Furnace Brook,	127 86	173 46	23 93	1,177 22	13 48	165 55	$4 20	228 11	194 88	2,108 69
Lynn Fells,	-	-	-	-	50 75	-	-	-	-	50 75
Lynnway,	-	-	-	13 50	2 11	-	-	-	-	15 61
Middlesex Fells,	-	3 90	253 50	227 18	98 18	43 10	90	86 15	48 85	761 66
Middlesex Fells Roads,	-	-	1,920 95	51 10	-	-	-	-	-	1,972 05
Mystic Valley,	34 10	90 15	664 82	187 20	32 68	125 92	-	35 95	-	1,120 82
Nahant Beach,	-	99 50	-	-	47 32	34 60	-	-	120 43	301 85
Neponset River,	40 15	1 60	1 50	28 50	9 03	5 45	-	115 33	-	201 56
Revere Beach,	324 80	157 74	4,581 99	1,102 11	19 82	595 46	18 72	173 05	4 40	6,978 09
Speedway (Charles River Reservation),	-	-	52 34	-	1 57	-	-	-	-	53 91
Parkway totals,	$540 64	$557 65	$8,918 73	$4,522 11	$300 15	$1,018 68	$23 82	$794 86	$499 98	$17,176 62

Reservations.										
Beaver Brook,	-	-	-	-	$98 90	-	-	-	-	$98 90
Blue Hills,	$19 00	$16 02	$6 00	$8 40	26 59	$0 80	-	-	$355 41	432 22
Charles River,	52 72	366 19	550 95	815 77	180 35	473 56	$34 20	$140 50	684 66	3,298 90
Hemlock Gorge,	-	3 60	93 18	12 00	-	-	-	-	-	108 78
King's Beach,	-	80	-	-	21 00	-	-	-	-	21 80
Lynn Shore,	41 30	-	10 50	353 85	43 91	37 28	-	-	-	486 84
Middlesex Fells,	-	20 25	3 00	-	35 49	66 30	-	17 90	21 00	163 94
Mystic River,	43 10	39 70	-	59 07	20 50	270 60	-	7 80	2 83	443 10
Nantasket Beach,	-	8 40	-	111 68	50 50	100 80	-	-	64 53	335 91
Neponset River,	215 17	128 12	58 13	21 00	27 66	596 64	-	25 00	1 60	1,073 32
Quincy Shore,	90 75	34 70	-	27 30	23 13	65 40	-	8 80	7 50	257 58
Revere Beach,	-	27 60	36 00	32 55	156 10	181 00	-	-	259 44	692 69
Stony Brook,	26 50	15 06	3 00	-	25 58	-	-	-	-	70 14
Winthrop Shore,	8 40	89 40	103 90	22 50	95 92	145 02	-	-	-	465 14
Reservation totals,	$496 94	$749 84	$864 66	$1,464 12	$805 63	$1,987 40	$34 20	$199 50	$1,396 97	$7,949 26
Miscellaneous,	-	-	-	-	720 00	-	-	-	-	720 00
Grand totals,	$1,037 58	$1,307 49	$9,783 39	$5,986 28	$1,825 78	$2,956 08	$58 02	$994 36	$1,806 95	$26,845 88

TABLE NO. 5. — *Prices paid for Principal Items of Construction.*

	PARKWAYS.			RESERVATIONS.		
	BLUE HILLS.	REVERE BEACH.		CHARLES RIVER.		MIDDLESEX FELLS.
CONTRACT No.,	53.	54.	55.	51.	56-A.	50-A.
Drains.						
8-inch vitrified pipe (lineal foot),	-	$0 40	$0 19	-	-	-
10-inch vitrified pipe (lineal foot),	$0 50	40	27	-	$0 40	-
12-inch vitrified pipe (lineal foot),	-	50	32	-	50	$0 40
15-inch vitrified pipe (lineal foot),	-	75	50	-	75	52
18-inch vitrified pipe (lineal foot),	-	90	65	-	1 00	-
20-inch vitrified pipe (lineal foot),	-	1 00	-	-	1 00	82
24-inch vitrified pipe (lineal foot),	-	-	-	-	-	1 90
30-inch vitrified pipe (lineal foot),	-	-	-	-	3 00	-
6-inch vitrified pipe underdrain (lineal foot),	-	45	-	-	-	-
Edgestones.						
Furnishing and setting (lineal foot),	1 00	1 15	75 1 25	-	-	-
Fences.						
Wooden, two rail (lineal foot),	-	-	17	-	-	-
Wooden, one rail (lineal foot),	-	12	13	-	-	-
Grading.						
Earth excavation (cubic yard),	80	19	23	-	30	30
Earth filling (cubic yard),	-	49	52	-	50	-
Rock excavation (cubic yard),	1 75	1 75 3 50	1 75	$1 50	-	-
Gutters.						
Vitrified brick paved (square yard),	-	2 00	1 70	-	-	-
Cobble-stone paved (square yard),	-	-	-	-	-	70
Masonry.						
Brick (cubic yard),	14 00	13 00	11 00	-	13 00	-
First class stone (cubic yard),	40 00	-	-	-	-	-
Rubble, dry (cubic yard),	-	-	-	-	-	4 25
Rubble, pointed (cubic yard),	-	3 50	-	-	6 00	-
Rubble, in mortar (cubic yard),	6 00	-	-	-	-	-
Concrete, Portland cement (cubic yard),	7 00	-	-	-	-	-
Surfacing.						
Broken stone (square yard),	30	45	45	-	-	-
Gravel roadway (square yard),	-	-	-	-	-	09
Gravel roadway, including furnishing (square yard),	-	-	33	-	28	-
Gravel walk (square yard),	20	21	21	-	-	-
Loam (square yard),	-	-	-	-	-	08
Loam (cubic yard),	-	36	30	-	30	-
Loam, including furnishing (cubic yard),	1 00	1 01	87	-	90	-

APPORTIONMENT COMMISSION.

COMMONWEALTH OF MASSACHUSETTS.

SUPREME JUDICIAL COURT.

SUFFOLK COUNTY. IN EQUITY.

IN THE MATTER OF THE PETITION OF WILLIAM B. DE LAS CASAS *et al.*, METROPOLITAN PARK COMMISSIONERS, *Petitioners.*

RESERVATION AND REPORT.

This is a petition brought by the Metropolitan Park Commission, under chapter 419 of the Acts of 1899, for the appointment of Commissioners to determine the proportions in which each of the cities and towns of the Metropolitan Park District shall annually pay money into the treasury of the Commonwealth for the first period of five years, to provide for the interest and sinking fund requirements, as estimated by the treasurer of the Commonwealth, for the appropriations and loans authorized by the statutes referred to in said Act of 1899, and to meet the expenses of maintenance and operation, as annually authorized by the General Court, and any deficiency in the estimates and payments, as found by the said Treasurer, and to return their award into this court, as provided by section 1 of said chapter.

Upon said petition the Apportionment Commissioners were appointed, and filed an award, which was objected to by several of the cities and towns interested; this award was accepted by a justice of this court, and the case reported to the full court.

After the coming down of the opinion of the full court (see William B. de las Casas *et al.*, petitioners), the award was recommitted by a decree, a copy of which is hereto attached.

Thereafter said Apportionment Commissioners filed a supplemental award, of which a copy is hereto attached.

The case came on for hearing before me on motion of the Attorney-General for the acceptance of said award, and it appeared that the award was objected to by the city of Newton, the town of Milton and the town of Brookline. The latter town filed a motion to recommit the award, of which a copy is hereto attached.

I was of the opinion that the questions arising upon the motions of the Attorney-General and of the town of Brookline should be reserved for the consideration of the full court; the previous report by Mr. Justice Barker, together with the tables and schedules and statements annexed thereto, may be referred to and treated as a part of this report; and in the consideration of the questions arising in this case, the full court may assume all the facts and matters stated in said previous report to have been found by me; and I reserve the case for the consideration of the full court, such order and disposition to be made of it as the full court may deem proper.

WILLIAM CALEB LORING, J.S.J.C.

May 28, 1901.

COMMONWEALTH OF MASSACHUSETTS.

Supreme Judicial Court.

Suffolk, ss. In Equity.

IN RE WILLIAM B. de las CASAS *et als.*, METROPOLITAN PARK COMMISSIONERS, *Petitioners.*

Decree.

And now, after the filing of the rescript from the Supreme Judicial Court, this cause came on to be heard upon the motions of the town of Brookline, the city of Newton and the city of Cambridge, for the recommittal of the award of said Commissioners; and after hearing counsel for said town of Brookline and counsel for the said petitioners, —

It is ordered, adjudged and decreed that said award be recommitted to said Commissioners, with instructions to report the grounds of their determination in such form as to enable the court to determine whether the award rests entirely on correct propositions of law.

By the court,

JOHN NOBLE,
Clerk.

March 12, 1901.

SUPPLEMENTAL AWARD.

Pursuant to the order of court of March 12, 1901, and as a supplement to their award heretofore filed, the Commissioners of Apportionment appointed in said cause now make the following report of the grounds of their determination: —

At the hearing before us it was claimed by certain municipalities that we should assess by population, — by the town of Brookline, that we should deviate from the ordinary mode of valuation assessment, and make the apportionments on a basis of population and valuation combined. Such a deviation is important. It would increase the assessment of Weymouth one-half and lessen that of Brookline by 40 per cent.

Another series of municipalities claimed that valuation should be the basis of apportionment. The method by population either alone or in combination threatened injustice to the poor and populous towns and cities, and unduly burdened the individual tax payer in such places for no good reason shown to us by evidence or argument.

The method of apportionment by valuation had also danger of injustice. A valuation already hypothecated to heavy and continuous public duty is not worth its full face value for the purposes of this cause. Another valuation, which easily and at a low rate bears its existing public duties, is more powerful.

We disapproved assessment by population. We deviated somewhat from an assessment by valuation. We started, however, with that method; the same was affected by credits and debits, as later set forth.

Anticipations of Park Expenditures.

A limitation of the liability of the city of Boston to .50 was made by law, by reason of previous large expenditures by that city of parks and driveways open to the public and especially available to the town of Brookline in respect to Jamaica Plain Reservation, Muddy Brook Driveway, the Fenway, Franklin Park and the Arnold Arboretum.

Upon careful inquiry into the facts, this limitation commended itself to our judgment, in respect of both parks and boulevards. In point of fact, it had reduced the percentage of Boston to .50 from about .62 of its proportion on strict valuation basis. But certain other municipalities had an equity to a limitation analogous to that allowed to the city of Boston, or to the established sewer system of Winthrop, referred to in 153 Mass. 584. Notably the city of Cambridge had made great expenditure in similar direction, and to a percentage, as compared with its valuation, even larger than that of the city of Boston in its entire park system. The town of Brookline had in the same way largely anticipated the Metropolitan Park Commission. The city of Lynn had already provided for the public the splendid Lynn Woods, of about two thousand acres, and maintains it.

Other municipalities had done more or less in the same direction. Equity required that we should make allowances to these places, as well as to the city of Boston; and we made it, in corresponding ratios, in favor of Cambridge, Brookline, Lynn, Newton and other places which had made outlay for parks that could properly be deemed part of a Metropolitan Park system.

Park Betterments.

Certain towns claimed that we should assess such betterments against other towns, by reason of their alleged proximity to some park or reservation.

We repeatedly asked the counsel representing the town of Brookline, and others representing similar views, to furnish us evidence why and to what extent this should be done, and were furnished nothing but a list of places which it was claimed by the town of Brookline had received park betterments. We made similar request of a city solicitor, who was making the same claim. His reply was, "I should not care to arouse enmity among my brethren."

It was not shown whether proximity or car facilities were more efficient in bringing visitors to parks, nor whether the enjoyment was by carriage parties from a distance or by foot travel from contiguous towns, nor any statistics, data or evidence as to whence came or where resided the users and enjoyers of the parks, nor their effect upon real estate.

Municipalities containing parks argued for credits for loss of taxable property, and claimed that there was no evidence making park betterment assessments possible, and that to do so would be guess-work. This claim was found to be true. The subject was left so completely obscure that we could not justify any named betterment figures, and especially could not name the grounds for any such finding. We did not assess any park betterments.

Boulevard Betterments.

It was claimed by the town of Brookline and certain other towns that such betterments ought to be assessed. This was more tangible and practicable. Those great roads appreciated real estate values, obviated need and cost of town ways, etc. The assessment of road betterments is not novel. We were not required to discriminate between abutting owners and the township containing them. In applying our apportionment percentages to boulevard cost, the Commonwealth was by law to pay one-half of such cost. The city of Boston's .50 would cover one-quarter, and the residue one-quarter would devolve on the Metropolitan Park District (exclusive of Boston).

We found that an equal division of this residue between township and district was fair and just, and we assessed one-eighth of boulevard cost against the township wherein such outlay for boulevards (whole or fractional) has been made.

Allowances to Overburdened Cities and Towns.

As stated above, the word "valuation," as a test of strength to bear park burdens, is not satisfying. It may be already pledged to an annual charge of $19.60, as in Braintree, or $20.50, as in Weymouth, to take care of roads, lighting, police, fire protection, health, sewers, schools, paupers, etc., as civilization and usage require for a large population, and with little property per capita. On the other hand, the valuation of Nahant, $6,557,070, with its population of 865, *i.e.*, a wealth per capita of $7,580 and a tax rate of $8 on a thousand, pledged for comparatively but little, in respect of duties already existing, for roads, paupers, schools, etc., is stronger.

Suggestions were made to us concerning an alleged tendency of personal wealth towards places of low taxation rates, in what are sometimes styled "refuges from oppression." It is a perfectly legal course for a man to select his home in reference to such a purpose, as well as for purposes of health, ocean breezes, contiguity of friends, etc. It does not, however, follow that, because a refuge town has been favored with immunity from high taxation under laws regulating town, county and State assessment, it is entitled to similar immunity in respect to burdens of the Metropolitan Park District, with its different mode of assessing.

Again, the valuation of Brookline ($4,593 per capita), hypothecated to existing public duties to the extent of $10.20 on a thousand, cannot justly be compared in mere proportion of dollars with that of Saugus ($755 per capita), and already hypothecated to annual public duties to the extent of $19.80 on a thousand.

A thousand dollars in Saugus is not the equal of the same sum two miles away in Nahant, or four miles away in Swampscott, where the tax rate is $11. If it be suggested that when assessors value a Saugus house at $1,000 they discount public burdens, the reply would be, let the citizen owner sell it for that sum; the money is subject in his hands to $19.80 of annual public duty. Besides, when tax rates grow large, the functionaries do not value down, they value up. We could not learn of any tendency to cure these discrepancies. On the contrary, money does seem to flow to the line of low taxation, and in so doing lowers it still more.

It is true that public burdens heretofore existing have been borne by property valuation, under very numerous laws. The creation of the Metropolitan Park District made a new and peculiar entity. Its outlay was to be enormous, but none of such assessment laws were made applicable to it. No way exists to meet this outlay except by the judgment of Commissioners. The Legislature has prescribed no guide for their judgment except that to be "just and equitable," even going so far as to enact that it shall be "*as they deem*" just and equitable.

This is a striking departure from previous methods of Massachusetts assessment and taxation. The Commissioners' results, to be operative, must meet the approval of the court, — a safeguard against error in law, at any rate, and against any neglect of constitutional rights when such rights apply to towns and cities.

This remarkable deviation from modes heretofore in use for raising funds for public purposes seemed to require us to examine widely, not only in regard to one public requirement, but also into the circumstances and situation to which this new demand has been appended.

We did not feel at liberty to treat this park cost apportionment as an isolated subject, or one devoid of circumstances, but rather as an additional public duty, to be dealt with in connection with those already existing, — as a new burden superinduced upon others already unequally borne, — and that an award might be possible which should leave less inequality for the next five years.

Classification.

We found that the thirty-nine cities and towns of the district readily grouped themselves into three classes. A scientific writer says that a municipality with less than $1,000 per capita is too weak to meet the requirements of modern civilization and usage.

Class 1 contains the places which we found needed relief (none of their per capita valuations reach $1,000).

Class 2 contains the great bulk of the average municipalities.

Class 3 contains those of per capita valuations exceeding $2,000; total valuations about the same as those of Class 1.

The city of Lynn is a specimen of Class 1. It has to provide for the legitimate public needs of 62,354 people, with property per capita $844; its tax rate is $18. The town of Weymouth is another, having to provide, as above, for 11,291 people, with a per capita valuation of $635; its tax rate is $20.50. Its citizen holding a 3½ per cent. bond of the Commonwealth, with thirty-seven years to run, nets on the market value of his bond but .77 of 1 per cent. Woburn must provide for 14,178 people, with a per capita property of $740; its tax rate is $17.80. Chelsea, for 31,264, with a per capita of $757; its tax rate is $18.50. Stoneham, for 6,284, with a per capita of $784; tax rate, $20.

More fortunate examples are: Milton, per capita, $4,022; tax rate, $11. Weston, per capita, $2,540; tax rate, $8.

We found that tax rates, no special or temporary circumstance intervening, indicate with a considerable uniformity the per capita wealth or poverty of a town, — high when the per capita valuation is small, low when it is large.

The principle of helping classes of poor towns has recognition (though not a complete analogy) in various general laws relating to school expenditure by allowances from the school fund since Public Statutes, chapter 43, in ratios increasing with subsequent laws; so that towns of less than $500,000 valuations receive $300 a year, and when the tax rate in this particular class of towns reaches $18, $50 additional.

Those from $500,000 to $1,000,000 receive $200 a year; those from $1,000,000 to $2,000,000 receive $100 a year; those from $2,000,000 to $3,000,000 receive $50 a year; and towns of less than $350,000 valuation receive $2 weekly for each teacher.

So, too, the State pays $1,250 annually to a union district of small towns (for superintendence), and if a town of larger valuation is in the district, the money goes only to the small towns (1893, chapter 272; 1897, chapter 498; 1898, chapter 466).

In determining what percentage allowance ought to be made in favor of Class 1, we found difficulties multiply with increasing percentages; but we were convinced that an abatement of .25 in the assessments upon valuation of Class 1, and a transfer of the amount of the abatements to Class 3, was called for and just, and was within the scope of correctness and safety. We decided to make that abatement, and did so, adding the sum of the abatements, $15,260, .22, viz., 3.58 per cent. of the entire amount apportioned, to the assessments of the municipalities of Class 3, in proportion to valuation.

Individual Consideration.

After arriving at the apportionment of each municipality upon the foregoing grounds, the commission proceeded to consider the case of each one and the proportion assigned to it, individually and on its own merits. We considered all the evidence and the facts appearing on the views which were taken, and adjudged that on the evidence and facts we deemed each assessment in itself just and equitable.

All prayers for rulings were denied except so far as granted above.

CHARLES FRANCIS ADAMS.
THOMAS M. STETSON.
JOHN C. HAMMOND.

COMMONWEALTH OF MASSACHUSETTS.

SUPREME JUDICIAL COURT.

SUFFOLK, ss. IN EQUITY.

WILLIAM B. DE LAS CASAS *et al.*, *Petitioners.*

OBJECTIONS OF THE TOWN OF BROOKLINE TO THE AWARD AND SUPPLEMENT THERETO OF THE APPORTIONMENT COMMISSIONERS.

And now comes the town of Brookline, one of the parties respondent in the above-entitled cause, and objects to the said award and supplement thereto of said commissioners, for the following reasons: —

First. — Because it does not appear, from the said award and supplement thereto, that the results arrived at by said Commissioners rest upon sound propositions of law.

Second. — Because the said award is inequitable as respects this respondent, and charges it with an unreasonable and extravagant proportion of the cost apportioned.

Third. — Because it cannot be ascertained, from anything contained in said award and supplement, what the exact method of apportionment adopted by the said Commissioners was; and because said Commissioners have refused to make known the method adopted by them, so as to enable this respondent to follow the method of working out their results, and ascertain whether the excessive share of the cost allotted to this respondent is due to clerical error in computation, or to the consideration of some improper and incompetent ground as the basis of said assessment.

Fourth. — Because there are apparently important errors in the matters stated in said award as the grounds upon which rest the results arrived at by said Commissioners: for example, the statement that the total valuations of Class 3 are "about the same" as those of Class 1, whereas, in fact, the total valuations of all places which can be grouped in Class 1, under the limitations described (that none of their per capita valuations reaches $1,000), is $237,744,088; and the total valuation of Class 3 (including places whose per capita valuation exceeds $2,000), omitting Boston and Cohasset, amounts to $170,214,406; if Boston and Cohasset are both included, $1,246,205,217; if Cohasset and not Boston is included, $176,481,632; and neither of said amounts is "about the same" as the total valuation of Class 1, above mentioned. Also, the statement that the sum of $15,260.22, transferred from Class 3 to Class 1, is 3.58 per cent. of the entire amount apportioned; whereas, the entire amount apportioned is the amount fixed by the Treasurer of the Commonwealth, as provided by law, to meet the interest and sinking fund requirements and cost of maintenance; and said amount, for parks, is $395,941.77; for parks including Nantasket, $428,707.04; and for parks, boulevards and Nantasket, $517,923.17; and the said sum of $15,260.22 is not 3.58 per cent. of either of said amounts. (See the tables hereto annexed.)

Fifth. — Because the said Commission has rejected all consideration of special benefits received by the various cities and towns on account of the parks established as the Metropolitan Park System, for the reason, as alleged in said award, that they were not furnished with statistics and evidence as to "whence came or where resided the users and enjoyers of the parks," and other evidence which it was obviously impossible for said respondents to introduce; whereas, such benefits are a matter of judgment, within the jurisdiction of said Commissioners to decide, without statistics or such evidence as they have referred to.

Sixth. — Because, although the chairman of said Commissioners informed this respondent that one of the reasons on account of which this respondent was assessed in excess of other municipalities was its proximity to the park system of the city of Boston, which had been constructed prior to the passing of the Metropolitan Park Act, and subsequently stated that this reason would appear in their report (whereupon counsel for this respondent gave written notice to said chairman of the intention of said respondent to object thereto), yet said report, although referring to this consideration by stating that the park system of Boston is "especially available" to this respondent, does not state how much this respondent's share of said assessment has been added to for that reason; and this respondent says that any benefits derived from such proximity were not due in any way to the cost of the Metropolitan Park System with which said Commissioners had to deal; and any benefit received therefrom had accrued prior to the establishment of said Metropolitan Park System, and was offset by the large expenditures which this respondent had incurred for its own park system, which is especially available to the city of Boston; and the proximity of said Boston parks ought not to be reckoned as a special benefit for which this respondent should be charged, particularly as all consideration of the special benefits resulting from the Metropolitan Parks to other cities or towns has been rejected; and this respondent is informed and believes, and therefore alleges, that said award as respects this respondent rests in part upon the consideration of benefits accruing from said Boston parks, and that such benefits ought not, as a matter of law, to have been considered.

Seventh. — Because it appears that said Commission have adopted an erroneous and illegal method of apportioning said expense, by attempting at the same time to equalize other burdens with which said Commission had nothing to do, and by transferring arbitrarily, and without just ground, the sum of $15,260.22 from the towns referred to as Class 3 to those referred to as Class 1; the effect of which transfer is to charge this respondent with the payment of $6,656.89 more annually than it would otherwise be obliged to pay.

Wherefore this respondent moves that said award be set aside, and this case recommitted to said Commissioners for further hearing.

INHABITANTS OF THE TOWN OF BROOKLINE,

By their Attorney,
WILLIAM D. TURNER.

SPECIAL REPORT ON NAHANT BEACH BATH-HOUSE.

[HOUSE, No. 79, 1902.]

COMMONWEALTH OF MASSACHUSETTS.

To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts in General Court assembled.

The Metropolitan Park Commission presents herewith the special report required by chapter 107 of the Resolves of 1901, upon the matter of a bath-house and sanitary station at Nahant Beach. The resolve is as follows: —

> *Resolved*, That the metropolitan park commission is hereby authorized and requested to investigate the desirability and feasibility of constructing and maintaining a public bath-house and sanitary station upon that part of the metropolitan reservation known as Nahant beach, and to report the result of the investigation to the next general court not later than the second Monday in January.

The Commission has investigated the subject matter of this resolve by personal inspection of Nahant Beach and of its public use during the past summer, by public hearings to official representatives and citizens of Nahant and Lynn, and by the reports and estimates of the Engineer, Architect and Landscape Architect.

Nahant Beach is on the ocean side of the Nahant Shore where it curves into the Lynn Shore at Oceanside Park, a local park of the city of Lynn. It forms part of the Metropolitan Park holdings, which include in this neighborhood nearly all the shore on both the ocean and harbor side of the only highway between Nahant and the main land of Lynn. These holdings were acquired with the concurrence of the selectmen of Nahant, who acted under a vote of the town. With the exception of a few parcels of land, they were entirely the property of the town of Nahant, and were, in effect, a gift made by the town, in order that buildings that were unsightly and distasteful to the townspeople might be removed, and the shore cared for in such a way as to restore and preserve its natural beauty. This desire was not included in any formal agreement, but it is so well understood that the Commission considers it as in effect a trust, to be administered with reasonable regard for both the wishes of the townspeople and the necessities of the public in their use of the reservation.

As soon as possible after acquiring the shore as above described, the Commission caused all buildings to be removed except a few private bath-houses at the end nearest the main portion of Nahant, which had been used by prominent citizens of the town for many years, under a license from the selectmen. The buildings removed were hotels, amusement stands of all kinds, and a large number of bath-houses on the ocean side, and houses, sheds and other minor buildings on the harbor side. The beauty of the beach was immediately restored and made apparent, but the public resorting to the beach were left without the usual and necessary accommodations. A private establishment on the harbor side within the city of Lynn furnished the only accommodations, and out of consideration to the public needs, the general rules of the reservation were modified so as to allow bathers to cross the highway from this establishment in bathing costume to reach the beach within the reservation. Although a very considerable use continued to be made of the beach, there were many protests and requests for improved accommodations.

The above facts, together with the observations of the Commission and its officers, and the testimony given at the hearings in regard to the matter, make it seem clear that there will continue to be a very large use of this beach and shore, and that the public will always require reasonable accommodations of the sort usually provided in the neighborhood of a bathing beach. Such accommodations ought to include sanitaries, a room for the emergencies of sudden illnesses and accidents, detention rooms for those arrested for the violation of the law, bath-houses, and shelters against the sun and sudden showers.

The Commission also finds that it is reasonable to expect that these accommodations will be provided at the expense of the Metropolitan Parks District. Nahant Beach has always been used more largely by people of the adjoining city of Lynn, and of other cities and towns within and even beyond the Metropolitan District, than by the people of Nahant. The adjoining shore within the city of Lynn, while equally beautiful and already developed by the expenditure of considerable money, is not a good bathing beach. In years past Nahant has had no inducement to provide public accommodations on this beach, and Lynn and the people beyond could not provide them. It cannot be reasonably expected that either municipality will in the future wish to pay for the cost of public accommodations on the beach. Nahant has given its property to the District, while Lynn has already provided at its own expense such important local parks that they will be considered valuable additions to the Metropolitan Parks. Both municipalities are somewhat removed from the rest of the District and its park system, and yet are obliged to join in the cost of maintaining the system.

In considering the matter of providing accommodations recommended, the Commission has found that the wishes of the townspeople of Nahant, which it believes ought to be respected, happily coincide with what will provide reasonably for the public necessities, and with what will clearly be the best development of the beach as a public park.

Plans embodying these ideas have been prepared in preliminary form, which provide for the necessary buildings of attractive appearance upon land of the reservation on the harbor side, with an approach to the bathing beach on the ocean side by a subway under the highway, — a plan very similar to, but upon a smaller scale than, that adopted and now so successfully in use at Revere Beach. The buildings on the harbor side include 500 bath rooms, and a head-house with public sanitaries, emergency and detention rooms. The highway is to be elevated to the grade of the crest of the beach, which will allow for the subways, and will conform to the grade to the proposed extension of the esplanade of Lynn Oceanside Park, overlooking the bathing beach. By this plan the only available land for buildings of the necessary size is utilized, the attractiveness of the highway is increased, and the wonderful beauty of the uninterrupted sweep of ocean view is preserved.

For economy of first cost and of cost of maintenance, it is planned that the reservation and the bath-house, if built, shall remain under the same general supervision as Revere Beach, and that the laundry and clerical work shall be done at the bath-house on that beach. The buildings on the harbor side will cover an area of about 16,000 square feet, and will cost approximately $40,000; the equipment with necessary furniture, apparatus for heating water and other machinery, and the equipment of bath suits and towels, will cost $8,000; the changes in the road and about buildings to conform to the crest of the beach will cost $18,000; making a total for necessary buildings, work and equipment, of $66,000. This amount does not include the cost of the esplanade on the ocean side.

Respectfully submitted,

WILLIAM B. DE LAS CASAS,
EDWIN U. CURTIS,
DAVID N. SKILLINGS,
ELLERTON P. WHITNEY,
Metropolitan Park Commissioners.

Mr. Haskell of the Commission is absent from the State, and therefore does not sign this report.

FINANCIAL STATEMENT.

DEC. 1, 1900, TO DEC. 1, 1901.

Metropolitan Parks Loan,	$6,855,000 00
Receipts from bath-house, sales, etc.,	198,334 01
	$7,053,334 01

Expenditures.

General expense: —				
Engineering: —				
Pay rolls,	$480 00			
Expenses,	499 67			
		$979 67		
Landscape Architects, expenses,		13 97		
Legal,		2,169 19		
Claims,		1,708 34		
Salaries,		1,641 68		
Plans,		39 17		
Stationery,		25 22		
Miscellaneous,		27 59		
			$6,604 83	
Blue Hills Reservation: —				
Land,		$1,230 00		
Engineering: —				
Pay rolls,	$432 22			
Expenses,	43 18			
		475 40		
Landscape Architects: —				
Services,	$550 00			
Expenses,	381 99			
		931 99		
Legal,		5 35		
House (partial),		3,759 37		
Construction,		738 49		
Heater for stable,		205 00		
Police,		114 75		
Repairs, Marigold Lodge,		56 43		
Galvanized pipe,		81 14		
Miscellaneous,		3 50		
			7,601 42	
Amounts carried forward,			$14,206 25	$7,053,334 01

Amounts brought forward, . . .			$14,206 25	$7,053,334 01
Middlesex Fells Reservation: —				
Land, ...		$2,367 00		
Engineering: —				
Pay rolls, . .	$458 44			
Expenses, . .	85 52			
		543 96		
Landscape Architects: —				
Services, . .	$50 00			
Expenses, . .	147 44			
		197 44		
Legal, ...		27 25		
Claims, ...		3 70		
House (partial), . . .		1,907 28		
Construction, . . .		214 37		
Police, ...		74 38		
Miscellaneous, . . .		5 95		
			5,341 33	
Revere Beach Reservation: —				
Land, ...		$21,982 92		
Engineering: —				
Pay rolls, . .	$692 69			
Expenses, . .	13 45			
		706 14		
Legal, ...		777 38		
Land experts, . . .		1,275 00		
Bath-house,* . . .		10,348 72		
Plans, bathing pool, . .		500 00		
Police, ...		131 35		
			35,721 51	
Stony Brook Reservation: —				
Land, ...		$1,192 50		
Engineering: —				
Pay rolls, . .	$70 14			
Expenses, . .	60			
		70 74		
Landscape Architects: —				
Services, . .	$100 00			
Expenses, . .	72 27			
		172 27		
Legal, ...		11 11		
Claims, ...		35 00		
Police, ...		26 50		
Construction, . . .		24 00		
			1,532 12	
Amounts carried forward, . . .			$56,801 21	$7,053,334 01

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* For itemized account, see page 34.

Amounts brought forward,			$56,801 21	$7,053,334 01
Beaver Brook Reservation: —				
Engineering: —				
Pay rolls,	$99 90			
Expenses,	5 20			
		$105 10		
Construction,		16 00		
			121 10	
Hemlock Gorge Reservation: —				
Engineering: —				
Pay rolls,	$108 78			
Expenses,	20 04			
		$128 82		
Landscape Architects, services,		25 00		
Police,		15 75		
Construction,		2 50		
			172 07	
Charles River Reservation: —				
Land,		$79,731 38		
Engineering: —				
Pay rolls,	$193 76			
Expenses,	3,298 90			
		3,492 66		
Landscape Architects: —				
Services,	$575 00			
Expenses,	356 27			
		931 27		
Legal,		1,616 57		
Claims,		782 00		
Land experts,		5,183 55		
Construction: —				
Charles River Road,	$9,888 90			
Border Road,	1,654 61			
Labor and materials,	1,125 10			
		12,668 61		
Dredging,		941 30		
Right to maintain landing,		200 00		
Plans, boat house,		50 00		
Advertising,		135 11		
House rent,		200 00		
Police,		56 50		
Miscellaneous,		20 50		
			106,009 45	
Amounts carried forward,			$163,103 83	$7,053,334 01

Amounts brought forward, . . .			$163,103 83	$7,053,334 01
Neponset River Reservation: —				
Land, ...		$32,203 67		
Engineering: —				
Pay rolls, . .	$1,073 32			
Expenses, . .	26 62			
		1,099 94		
Landscape Architects: —				
Services, . .	$185 00			
Expenses, . .	64 29			
		249 29		
Legal, ...		1,590 28		
Claims, ...		200 00		
Land experts, . . .		1,628 05		
Construction, . . .		124 45		
Trees, ...		18 25		
Miscellaneous, . . .		18 90		
			37,132 83	
Mystic River Reservation: —				
Land, ...		$50,145 72		
Engineering: —				
Pay rolls, . .	$443 10			
Expenses, . .	10 45			
		453 55		
Landscape Architects: —				
Services, . .	$350 00			
Expenses, . .	294 56			
		644 56		
Land experts, . . .		2,425 00		
Legal, ...		179 41		
Claims, ...		280 00		
			54,128 24	
Lynn Shore Reservation: —				
Land, ...		$6,200 00		
Engineering: —				
Pay rolls, . .	$486 84			
Expenses, . .	3 25			
		490 09		
Legal, ...		26 65		
Fence, ...		163 00		
Construction, . . .		47 30		
Repairs to wall, . . .		45 05		
			6,972 09	
Amounts carried forward, . . .			$261,336 99	$7,053,334 01

Amounts brought forward,			$261,336 99	$7,053,334 01
Quincy Shore Reservation: —				
Land,		$13,429 00		
Engineering: —				
Pay rolls,	$257 58			
Expenses,	29 30			
		286 88		
Legal,		31 20		
Claims,		180 00		
			13,927 08	
Winthrop Shore Reservation: —				
Land,		$305 00		
Engineering: —				
Pay rolls,	$465 14			
Expenses,	16 10			
		481 24		
Legal,		599 75		
Claims,		100 00		
Construction,		366 86		
Police,		87 50		
Sprinkling wagon,		352 45		
Iron bracket,		45 00		
Stand-pipe,		30 00		
Photographs,		17 50		
Miscellaneous,		4 16		
			2,389 46	
Hart's Hill Reservation: —				
Land,		$10,000 00		
Legal,		83 60		
Plans,		3 75		
			10,087 35	
King's Beach Reservation: —				
Land,		$1,500 00		
Engineering pay rolls,		21 80		
			1,521 80	
			$289,262 68	
Amounts charged to Dec. 1, 1900,			6,135,498 20	
				6,424,760 88
Balance in hands of State Treasurer,				$628,573 13
Metropolitan Parks Loan, Series II.,				$3,025,000 00
Receipts from sales, etc.,				29,907 41
				$3,054,907 41
Amount carried forward,				$3,054,907 41

Amount brought forward,				$3,054,907 41
		Expenditures.		
General expense: —				
Engineering: —				
Pay rolls,	$344 66			
Expenses,	288 58	$633 24		
Landscape Architects: —				
Services,	$160 00			
Expenses,	75 67	235 67		
Legal,		2,189 45		
Claims,		1,571 67		
Stenographic report,		51 75		
Miscellaneous,		35 40	$4,717 18	
Blue Hills Parkway: —				
Land,		$16,200 00		
Engineering: —				
Pay rolls,	$2,873 34			
Expenses,	412 00	3,285 34		
Landscape Architects: —				
Services,	$100 00			
Expenses,	82 79	182 79		
Legal,		383 73		
Construction, Mattapan Bridge,		5,277 31		
Labor,		190 85		
Repairs, Mattapan Bridge,		388 50		
Architects' services,		530 39		
Advertising,		136 43		
Watering cart,		352 45		
Sand sprinkler,		49 92		
Photographs,		12 00	26,989 71	
Middlesex Fells Parkway: —				
Land,		$11,976 19		
Engineering: —				
Pay rolls,	$761 66			
Expenses,	145 35	907 01		
Landscape Architects: —				
Services,	$75 00			
Expenses,	52 90	127 90		
Am'ts carried forward,		$13,011 10	$31,706 89	$3,054,907 41

Am'ts brought forward,		$13,011 10	$31,706 89	$3,054,907 41
Legal,		119 19		
Experts:—				
Legal,	$625 00			
Claims,	225 00			
		850 00		
Construction (labor and materials),		848 62		
Sand sprinkler,		146 70		
			14,975 61	
Mystic Valley Parkway:—				
Land,		$15,195 00		
Engineering:—				
Pay rolls,	$1,120 82			
Expenses,	84 10			
		1,204 92		
Landscape Architects, expenses,		23 80		
Legal,		173 51		
Experts:—				
Legal,	$175 00			
Claims,	8 00			
		183 00		
Construction (labor and materials),		9,411 22		
Sand sprinkler,		98 18		
Miscellaneous,		1 00		
			26,290 63	
Revere Beach Parkway:—				
Land,		$101,169 68		
Engineering:—				
Pay rolls,	$7,030 27			
Expenses,	355 31			
		7,385 58		
Landscape Architects:—				
Services,	$125 00			
Expenses,	74 16			
		199 16		
Legal,		1,337 68		
Experts:—				
Legal,	$1,681 85			
Claims,	1,515 00			
		3,196 85		
Am'ts carried forward,		$113,288 95	$72,973 13	$3,054,907 41

Am'ts brought forward,		$113,288 95	$72,978 13	$3,054,907 41
Construction: —				
Contract,	$123,428 45			
Labor and materials,	2,436 90			
		125,865 35		
Edgestone, Waverley Avenue entrance,		37 14		
Photographs,		116 00		
Advertising,		393 28		
Sand sprinkler,		11 86		
Miscellaneous,		1 88		
			239,714 46	
Neponset River Parkway: —				
Land,		$6,575 41		
Engineering: —				
Pay rolls,	$201 56			
Expenses,	14 80			
		216 36		
Landscape Architects, expenses,		1 96		
Legal,		10 22		
Experts: —				
Legal,	$270 00			
Claims,	150 00			
		420 00		
			7,223 95	
Fresh Pond Parkway: —				
Land,		$12,000 00		
Engineering: —				
Pay rolls,	$253 05			
Expenses,	18 70			
		271 75		
Landscape Architects: —				
Services,	$25 00			
Expenses,	18 12			
		43 12		
Legal,		33 02		
Crossing, Brattle Street,		195 17		
Construction (labor and materials),		273 00		
Sand sprinkler,		18 34		
Signs,		40 50		
Photographs,		7 50		
Advertising,		2 00		
Serving betterment notices,		4 00		
			12,888 40	
Amounts carried forward,			$332,799 94	$3,054,907 41

Amounts brought forward, . . .			$332,799 94	$3,054,907 41
Furnace Brook Parkway: —				
Land, ...		$42,704 39		
Engineering: —				
Pay rolls, . .	$2,322 80			
Expenses, . .	134 41			
		2,457 21		
Landscape Architects: —				
Services, . .	$150 00			
Expenses, . .	44 96			
		194 96		
Legal, ...		653 18		
Experts, claims, . . .		755 00		
Bound stones, . . .		234 00		
			46,998 74	
Nahant Beach Parkway: —				
Engineering: —				
Pay rolls, . .	$214 73			
Expenses, . .	126 15			
		$340 88		
Legal, ...		137 05		
Experts, claims, . . .		75 00		
Construction (labor), . .		350 50		
Removal of hulks and débris,		175 00		
Photographs, . . .		70 00		
Removing dead horse, . .		5 00		
Signs, ...		4 80		
Miscellaneous, . . .		12 55		
			1,170 78	
Charles River Speedway: —				
Engineering: —				
Pay rolls, . .	$53 91			
Expenses, . .	9 77			
		$63 68		
Construction (labor and materials), . . .		112 10		
Fence, ...		120 00		
Photographs, . . .		20 00		
			315 78	
Blue Hills Roads: —				
Engineering: —				
Pay rolls, . .	$407 70			
Expenses, . .	30			
		$408 00		
			408 00	
Amounts carried forward, . . .			$381,693 24	$3,054,907 41

Amounts brought forward,			$381,693 24	$3,054,907 41
Middlesex Fells Roads: —				
Engineering: —				
Pay rolls,	$1,677 55			
Expenses,	65 76			
		$1,743 31		
Construction: —				
Whitmore Brook entrance,	$9,742 70			
Labor and materials,	1,633 47			
		11,376 17		
Advertising,		101 24		
Miscellaneous,		4 25		
			13,224 97	
Lynnway: —				
Engineering pay rolls,		$15 61		
			15 61	
Middlesex Fells and Lynn Woods: —				
Engineering pay rolls,		$50 75		
			50 75	
			$394,984 57	
Amount charged to Dec. 1, 1900,			2,453,343 49	
				2,848,328 06
Balance in hands of State Treasurer,				$206,579 35

Nantasket Beach Loan,			$700,000 00
Receipts, rents, etc.,			5,881 50
			$705,881 50

Expenditures.

Land,		$136,624 19	
Engineering: —			
Pay rolls,	$335 91		
Expenses,	21 85		
		357 76	
Landscape Architects: —			
Services,	$175 00		
Expenses,	182 24		
		357 24	
Legal,		1,222 68	
Police station,		13,481 58	
Amounts carried forward,		$152,043 45	$705,881 50

Amounts brought forward,		$152,043 45	$705,881 50
Repairs on buildings,		3,232 90	
Hook and ladder truck,		614 50	
Police,		417 50	
Filling,	$700 70		
Loam,	370 30		
		1,071 00	
Advertising,		412 31	
Laying brick,		356 40	
Well,		83 00	
Coal,		78 00	
Photographs,		31 00	
Water rates,		19 60	
Miscellaneous,		60 00	
		$158,419 66	
Amount charged to Dec. 1, 1900,		466,075 46	
			624,495 12
Balance in hands of State Treasurer,			$81,386 38

METROPOLITAN PARKS SYSTEM MAINTENANCE.

Appropriation for 1901,		$120,950 00

Expenditures.

General expense: —		
Salaries,	$9,350 00	
Rent,	3,160 49	
Steam road roller,	2,800 00	
Asphalt roller,	1,095 00	
Maps and books,	894 53	
Stationery,	689 10	
Office expenses,	348 58	
Travelling expenses,	325 51	
Expenses of apportionment commission,	322 41	
Telephones,	164 18	
Safe,	159 00	
Typewriters and cabinet,	120 40	
Filing cabinet,	117 50	
Bill file and index,	95 00	
Police,	70 81	
Book case,	51 39	
Photographs,	49 00	
Clocks,	20 50	
Am'ts carried forward,	$19,833 40	$120,950 00

Am'ts brought forward, .	$19,833 40		$120,950 00
Towel supply, . . .	28 25		
Letter press, . . .	20 00		
Electrical work, . . .	20 00		
Legal blank case, . .	16 70		
Lecture illustrating, . .	23 35		
Umbrella stand, . . .	3 49		
Desk, ...	8 50		
		$19,953 69	
Blue Hills Reservation: —			
Labor, ...	$5,456 48		
Police, ...	5,902 92		
Repair of roads, . . .	1,894 35		
Forestry, ...	2,555 75		
Repairs, Hillside Street, .	1,647 17		
General supplies, . .	375 80		
Keep of horses, . . .	1,607 80		
Horses, carriages, etc., .	937 15		
Repairs, ...	302 04		
Telephones, ...	234 73		
Tree guards, . . .	98 46		
Installing lights in stable, .	47 50		
Stationery, ...	23 30		
Chairs, ...	20 00		
Travelling expenses, . .	19 16		
Electric connections, . .	13 60		
Express, ...	9 49		
Water rates, . . .	7 04		
Miscellaneous, . . .	23 89		
		21,176 63	
Middlesex Fells Reservation: —			
Labor, ...	$7,562 67		
Police, ...	5,716 74		
Lighting, ...	501 48		
Repairs of roads, . . .	4,156 00		
General supplies, . .	1,713 52		
Sheds, ...	912 46		
Forestry, ...	698 80		
Keep of horses, . . .	563 16		
Horses, carriages, etc., .	465 12		
Telephones, ...	418 12		
Repairs, ...	215 00		
Travelling expenses, . . .	109 28		
Painting house, headquarters, ...	100 00		
Am'ts carried forward, .	$23,132 35	$41,130 32	$120,950 00

Am'ts brought forward, .	$23,132 35	$41,180 32	$120,950 00
Removing wire fence, . .	63 00		
Express, ...	48 38		
Transporting gypsy moth apparatus, . . .	36 00		
Screens, ...	27 50		
Outside windows, . .	25 36		
Water rates, . . .	23 50		
Duck, ...	17 05		
Water connection, . .	9 16		
Signs, ...	2 40		
Miscellaneous, . . .	81 53		
		23,466 23	
Revere Beach Reservation: —			
Labor, ...	$3,327 34		
Police, ...	11,138 20		
Watering, ...	499 20		
Lighting, ...	2,045 51		
Repairs of roads, . . .	1,837 48		
General supplies, . .	610 30		
Brick, ...	1,066 00		
Keep of horses, . . .	369 49		
Horses, carriages, etc., .	294 25		
Repairs, ...	270 66		
Telephones, ...	260 13		
Canvas covers, . . .	159 10		
Stone dust, ...	126 25		
Loam, ...	97 38		
Setting edgestones, . .	92 95		
Trees, ...	73 16		
Building catch-basin, . .	56 64		
Driving poles, . . .	60 00		
Teaming bricks, . . .	43 75		
Screens for fountain, . .	28 00		
Rubbish barrels, . . .	38 40		
Travelling expenses, . .	37 22		
Brick paving, . . .	27 50		
Water rates, . . .	24 00		
Bathing checks, . . .	9 00		
Express, ...	22 13		
Stationery, ...	8 05		
Frame, ...	4 50		
Posters, ...	1 50		
Cleaning catch-basin, . .	4 00		
Miscellaneous, . . .	70 01		
		22,702 10	
Amounts carried forward, ...		$87,298 65	$120,950 00

Amounts brought forward,		$87,298 65	$120,950 00
Stony Brook Reservation: —			
Labor,	$1,328 35		
Police,	1,290 72		
Repairs of roads,	380 30		
Forestry,	672 40		
General supplies,	93 19		
Keep of horses,	128 36		
Repairs,	104 93		
Telephones,	80 85		
Water rates,	62 00		
Travelling expenses,	24 70		
Horses, carriages, etc.,	13 70		
Signs,	10 88		
Inserting bracket lamp,	5 12		
Screen doors,	3 30		
Miscellaneous,	3 55		
		4,202 35	
Beaver Brook Reservation: —			
Labor,	$1,367 29		
Police,	192 40		
General supplies,	441 58		
Repairs,	145 11		
Keep of horses,	129 84		
Tree guards,	42 57		
Telephones,	28 67		
Laying floor,	24 00		
Horses, carriages, etc.,	17 42		
Gravel,	9 75		
Buoys,	9 50		
Miscellaneous,	13 90		
		2,432 03	
Hemlock Gorge Reservation: —			
Labor,	$336 60		
Police,	912 77		
General supplies,	131 12		
Repairs,	67 70		
Furniture,	61 00		
Floats,	44 11		
Water rates,	40 00		
Fence, Elliott Street,	18 24		
Flag halyards,	1 80		
Travelling expenses,	1 23		
Signs,	1 00		
		1,615 57	
Amounts carried forward,		$95,548 60	$120,950 00

Amounts brought forward, . . .		$95,548 60	$120,950 00
Charles River Reservation, Riverside Section: —			
Labor, ...	$1,545 61		
Police, ...	2,030 41		
Repairs of roads, . . .	157 60		
General supplies, . . .	328 09		
Loam, ...	195 55		
Fencing, ...	93 90		
Repairs, ...	85 19		
Life-saving appliances and care, ...	75 00		
Travelling expenses, . .	54 89		
Canoe, ...	40 20		
Row boat, ...	30 00		
Telephones, ...	37 39		
Water rates, ...	28 86		
Shades, Forest Grove, . .	20 45		
Signs, ...	15 50		
Storage of launch, . .	10 00		
Trees, ...	9 25		
Launch poles and pennants,	9 00		
Steering wheel, . . .	7 65		
Barrels for float, . . .	6 00		
Miscellaneous, . . .	22 78		
		4,803 32	
Charles River Reservation, Speedway Section: —			
Labor, ...	$4,820 58		
Police, ...	3,925 03		
General supplies, . . .	503 21		
Watering, ...	1,191 55		
Fencing, ...	275 04		
Repairs to Gillespie and Pierce wharf, . . .	550 88		
Loam and carting, . .	752 20		
Horses, carriages, etc., .	606 55		
Keep of horses, . . .	578 32		
Repairs, ...	397 78		
Grass seed, ...	60 20		
Telephones, ...	67 78		
Trees, ...	59 00		
Water rates, ...	55 75		
Gravel, ...	52 50		
Storm porch on office, . .	37 00		
Lighting, ...	21 90		
Am'ts carried forward, .	$14,055 27	$100,351 92	$120,950 00

Am'ts brought forward, .	$14,055 27	$100,351 92	$120,950 00
Grates, ...	16 02		
Stationery, ...	7 86		
Travelling expenses, . .	7 60		
Ice, ...	8 67		
Advertising, ...	5 25		
Miscellaneous, . . .	32 75		
		14,133 42	
Neponset River Reservation: —			
Labor, ...	$653 42		
Forestry, ...	543 55		
Travelling expenses, . .	5 00		
Miscellaneous, . . .	1 45		
		1,203 40	
Mystic River Reservation: —			
Labor, ...	$12 60		
Water rates, ...	58 40		
Cleaning cesspool, . .	16 00		
Repairs, ...	11 91		
Miscellaneous, . . .	56		
		99 47	
Lynn Shore Reservation: —			
Labor, ...	$134 13		
Police, ...	710 96		
Breakwater and repairs on wall, ...	330 00		
Filling cellars and fence, .	235 65		
General supplies, . . .	35 90		
Telephones, ...	18 84		
Travelling expenses, . .	16 25		
Miscellaneous, . . .	20 60		
		1,502 33	
Quincy Shore Reservation: —			
Labor, ...	$65 00		
		65 00	
Winthrop Shore Reservation: —			
Police, ...	$865 37		
Watering, ...	656 75		
Labor, ...	636 25		
General supplies, . . .	97 51		
Pointing wall, etc., . .	40 00		
Horses, carriages, etc., . .	26 00		
Am'ts carried forward, .	$2,341 88	$117,355 54	$120,950 00

Am'ts brought forward,	$2,341 88	$117,355 54	$120,950 00
Repairs,	23 60		
Changing stand-pipe,	10 48		
Miscellaneous,	2 60		
		2,358 56	
			119,714 10
Balance,			$1,235 90

Metropolitan Parks System Maintenance, Series II.

Appropriation for 1901,			$60,450 00
	Expenditures.		
General expense: —			
Salaries,	$7,168 15		
Rent,	2,714 18		
Rock-crushing plant,	2,200 00		
Stationery,	529 18		
Maps and books,	441 65		
Office expenses,	261 38		
Telephones,	175 26		
Travelling expenses,	74 75		
Typewriter,	60 50		
Photographs,	60 00		
Files,	57 00		
Towel supply,	45 20		
Taking down and storing awnings,	20 90		
Lecture illustrating,	8 00		
Desk chair,	7 00		
Miscellaneous,	10 45		
		$13,833 60	
Blue Hills Parkway: —			
Labor,	$1,195 80		
Police,	3,071 45		
Repairs of roads,	1,079 75		
Watering,	1,347 77		
Lighting,	2,430 00		
General supplies,	26 44		
Dam, Canton Avenue,	503 45		
Water rates,	108 74		
Telephones,	96 49		
Horses, carriages, etc.,	81 55		
Miscellaneous,	9 90		
		9,951 34	
Amounts carried forward,		$23,784 94	$60,450 00

Amounts brought forward,		$23,784 94	$60,450 00
Middlesex Fells Parkway: —			
Labor,	$3,164 24		
Police,	4,319 44		
Repairs of roads,	3,366 38		
Watering,	2,936 00		
Lighting,	6,030 00		
General supplies,	157 12		
Horses, carriages, etc.,	225 15		
Repairs,	174 75		
Telephones,	95 20		
Tree guards,	71 28		
Trees,	24 76		
Express,	1 50		
		20,565 82	
Mystic Valley Parkway: —			
Labor,	$2,644 48		
Police,	2,025 45		
Repairs of roads,	400 00		
Watering,	1,160 12		
Lighting,	2,580 00		
General supplies,	283 20		
Loam,	312 50		
Telephones,	238 85		
Repairs,	172 30		
Stationery,	93 00		
Horses, carriages, etc.,	66 19		
Drinking fountain,	62 00		
Trees,	58 20		
Water rates,	29 00		
Keep of horses,	26 35		
Miscellaneous,	12 85		
		10,164 49	
Revere Beach Parkway: —			
Labor,	$405 33		
Police,	779 00		
Watering,	400 00		
Lighting,	252 71		
General supplies,	248 14		
Re-covering Beachmont Bridge,	655 20		
Horses, carriages, etc.,	466 00		
Miscellaneous,	8 26		
		3,214 64	
Amounts carried forward,		$57,729 89	$60,450 00

Amounts brought forward,		$57,729 89	$60,450 00
Fresh Pond Parkway: —			
Labor,	$241 20		
Police,	808 50		
Watering,	174 54		
Lighting,	552 67		
Trees,	66 96		
Tool house,	65 00		
Loam,	35 00		
Carting loam,	30 00		
		1,973 87	
Nahant Beach Parkway: —			
Labor,	$540 00		
Telephones,	32 36		
Rubbish barrels,	19 20		
Travelling expenses,	3 35		
Miscellaneous,	5 66		
		600 57	
Stony Brook Roads: —			
Miscellaneous labor,	$7 65		
Repair of roads, labor,	58 20		
		65 85	
			60,370 18
Balance,			$79 82

NANTASKET BEACH MAINTENANCE.

Appropriation for 1901,		$15,000 00
Expenditures.		
Labor,	$1,641 65	
Police,	8,245 09	
Repair of roads,	1,445 83	
Watering,	641 45	
Lighting,	1,098 47	
General supplies,	906 67	
Water rates,	190 00	
Work at café,	197 51	
Telephones,	93 48	
Repairs,	87 09	
Dory,	54 56	
Fittings and furnishings for dormitory and station,	153 26	
Travelling expenses,	39 78	
Disinfectant,	37 50	
Amounts carried forward,	$14,832 34	$15,000 00

Amounts brought forward,	$14,832 34	$15,000 00
Physician's services,	24 00	
Architect's services,	30 00	
Electrical work, dormitory and station,	18 78	
Maps and books,	5 47	
Bathing checks,	5 00	
Express charges,	29 85	
Miscellaneous,	36 67	
		14,982 11
Balance,		$17 89

METROPOLITAN PARKS EXPENSE FUND.

Receipts to Jan. 1, 1902,			$63,354 61
Expenditures: —			
Revere Beach Reservation: —			
Bath-house,*	$21,164 55		
Repairs, Ocean Avenue,	85 00		
		$21,249 55	
Charles River Reservation: —			
Construction, Moody Street and Forest Grove,		1,623 85	
Neponset River Reservation: —			
Repairs to houses,		153 06	
Mystic River Reservation: —			
Repairs to houses,		15 39	
Quincy Shore Reservation: —			
Rebate on bath-house rent,		20 00	
Blue Hills Parkway: —			
Commission for renting house,		10 50	
Revere Beach Parkway: —			
Repairs to houses,		33 42	
Neponset River Parkway: —			
Water connections,		23 26	
Nantasket Beach Reservation: —			
Alterations and repairs on buildings,	$4,972 55		
Board walk,	182 00		
Furnishings, dormitory,	86 40		
		5,240 95	
			28,369 98
Balance,			$34,984 63

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* For itemized account, see page 34.

KEY TO LETTERS AND FIGURES ON THE MAP.

METROPOLITAN HOLDINGS.

A. King's Beach and Lynn Shore.
B. Revere Beach.
C. Revere Beach Parkway.
D. Fellsway.
E. Fellsway East.
F. Fellsway West.
G. Middlesex Fells Reservation.
H. Mystic Valley Parkway.
J. Beaver Brook Reservation.
K. Charles River Reservation.
L. Hemlock Gorge Reservation.
M. Stony Brook Reservation.
N. Neponset River Parkway.
O. Blue Hills Parkway.
P. Blue Hills Reservation.
Q. Nantasket Beach Reservation.
R. Quincy Shore Reservation.
S. Fowl Meadows.
T. Neponset River Reservation.
U. Mystic River Reservation.
V. Fresh Pond Parkway.
W. Whitmore Brook Entrance.
X. Furnace Brook Parkway.

	OPEN SPACES.	CONTROLLED BY —
1.	Boston Common	Boston Department of Public Grounds.
2.	Public Garden	Boston Department of Public Grounds.
3.	Commonwealth Avenue	Boston Park Commission.
4.	Charlesbank	Boston Park Commission.
5.	Back Bay Fens	Boston Park Commission.
6.	Blackstone Square	Boston Department of Public Grounds.
7.	Franklin Square	Boston Department of Public Grounds.
8.	Monument Square	Bunker Hill Monument Association.
9.	Charlestown Heights	Boston Park Commission.
10.	Charlestown Playground	Boston Park Commission.
11.	Wood Island Park	Boston Park Commission.
12.	Commonwealth Park	Boston Department of Public Grounds.
13.	Telegraph Hill	Boston Department of Public Grounds.
14.	Independence Square	Boston Department of Public Grounds.
15.	Marine Park	Boston Park Commission.
16.	Castle Island	Boston Park Commission.
17.	Rogers Park	Boston Department of Public Grounds.
18.	Chestnut Hill Reservoir	Metropolitan Water Board.
19.	Longwood Playground	Brookline Park Commission.
20.	Brookline Avenue Playground	Brookline Park Commission.
21.	Cypress Street Playground	Brookline Park Commission.
22.	Muddy River Parkway	Boston and Brookline Park Commission.
23.	Old Brookline Reservoir	Boston Water Board.
24.	Brookline Reservoir	Brookline Water Department.
25.	Fisher Hill Reservoir	Boston Water Board.
26.	Madison Square	Boston Department of Public Grounds.
27.	Orchard Park	Boston Department of Public Grounds.
28.	Parker Hill Reservoir	Boston Water Board.
29.	Highland Park	Boston Department of Public Grounds.
30.	Washington Park	Boston Department of Public Grounds.

OPEN SPACES.	CONTROLLED BY—
31. Fountain Square	Boston Department of Public Grounds.
32. Jamaica Pond	Boston Park Commission.
33. Arnold Arboretum	Boston Park Commission.
34. Franklin Park	Boston Park Commission.
35. Franklin Field	Boston Park Commission.
36. Dorchester Park	Boston Park Commission.
37. Squaw Rock	Boston Sewage Department.
38. Moon Island	Boston Sewage Department.
39. Merrymount Park	Quincy Park Commission.
40. Faxon Park	Quincy Park Commission.
41. Quincy Water Reserve	Quincy Water Commission.
42. French's Common	Braintree Selectmen.
43. Webb Park	Weymouth Park Commission.
44. Beals Park	Weymouth Park Commission.
45. Hull Common	Hull Park Commission.
46. Dedham Common	Dedham Selectmen.
47. Boston Parental School	Trustees.
48. Brookline Water Works	Brookline Water Department.
49. Brookline Water Reserve	Brookline Water Department.
50. Brookline Water Reserve	Brookline Water Department.
51. Newton Water Reserve	Newton Water Board.
52. Needham Common	Needham Selectmen.
53. Waban Hill Reservoir	Newton Water Board.
54. Farlow Park	Newton Street Commission.
55. Newton Centre Playground and Green	Newton Street Commission.
56. River Park, Weston	Weston Park Commission.
57. Auburndale Park	Newton Street Commission.
58. River Park, Auburndale	Newton Street Commission.
59. Stony Brook Storage Basin	Cambridge Water Board.
60. Waltham Water Works	Waltham Water Board.
61. Waltham Common	Waltham Department of Public Grounds.
62. Saltonstall Park	Watertown Park Commission.
63. United States Arsenal	National Government.
64. Fresh Pond Park	Cambridge Water Board.
65. Cambridge Common	Cambridge Park Commission.
66. Broadway Park	Cambridge Park Commission.
67. The Esplanade	Cambridge Park Commission.
68. Central Hill Park	Somerville Department of Public Grounds.
69. Broadway Park	Somerville Department of Public Grounds.
70. Nathan Tufts Park	Somerville Department of Public Grounds.
71. Mystic Reservoir	Boston Water Board.
72. Mystic Water Works	Boston Water Board.
73. Arlington Heights	Arlington Water Commission.
74. Arlington Water Reserve	Arlington Water Commission.
75. Lexington Common	Lexington Selectmen.
76. Boston Water Reserve	Boston Water Board.
77. Winchester Common	Winchester Selectmen.
78. Woburn Park	Woburn Park Commission.
79. Cotymore Lea	Malden Park Commission.
80. Sheridan Park	Malden Park Commission.
81. Fellsmere	Malden Park Commission.
82. Craddock Field	Malden Park Commission.
83. Ferryway Green	Malden Park Commission.
84. Playground	Stoneham Selectmen.
85. Wakefield Common	Wakefield Selectmen.
86. Lake Park	Wakefield Selectmen.
87. Sewall's Wood	Melrose Park Commission.
88. Eastern Common	Melrose Park Commission.
89. Waitt's Mount	Malden Park Commission.
90. Malden Water Works	Malden Water Board.
91. Union Park	Chelsea Park Commission.
92. United States Marine and Naval Hospital	National Government.

OPEN SPACES.	CONTROLLED BY—
93. United States Battery	National Government.
94. United States Battery	National Government.
95. Lynn Common	Lynn Park Commission.
96. Lynn Woods	Lynn Park Commission.
97. Lynn Water Reserve	Lynn Water Board.
98. Meadow Park	Lynn Park Commission.
99. Oceanside Terrace	Lynn Park Commission.
100. Nahant Long Beach	Transferred to Metropolitan Park Commission.
101. Nahant Short Beach	
102. Devereux Beach	Marblehead Selectmen.
103. Marblehead Park	Marblehead Park Commission.
104. Crocker Rock	Marblehead Park Commission.
105. Fort Sewall	Marblehead Selectmen.
106. Fort Glover	Marblehead Selectmen.
107. Prospect Hill	Waltham Department of Public Grounds.
108. Rindge Field	Cambridge Park Commission.
109. Winthrop Square	Cambridge Park Commission.
110. Cambridge Field	Cambridge Park Commission.
111. The Front	Cambridge Park Commission.
112. Charles River Parkway	Cambridge Park Commission.
113. Hastings Square	Cambridge Park Commission.
114. North Brighton Playground	Boston Park Commission.
115. Billings Field	Boston Park Commission.
116. Milton Playground	Milton Selectmen.
117. Milton Hill	Trustees Public Reservations.
118. Neponset Playground	Boston Park Commission.
119. Christopher Gibson Playground	Boston Park Commission.
120. M Street Playground	Boston Park Commission.
121. Mystic Playground	Boston Park Commission.
122. North End Park	Boston Park Commission.
123. West Roxbury Parkway	Boston Park Commission.
124. Watertown Water Works	Watertown Water Board.
125. Bullough Pond Park	Newton Street Commission.
126. Crystal Lake	Newton Street Commission.
127. Islington Park	Newton Street Commission.
128. Wolcott Park	Newton Street Commission.
129. Lincoln Park	Newton Street Commission.
130. Linwood Avenue Park	Newton Street Commission.
131. Elmwood Park	Newton Street Commission.
132. Washington Park	Newton Street Commission.
133. Cabot Park	Newton Street Commission.
134. Boyd's Pond Park	Newton Street Commission.
135. Walnut Park	Newton Street Commission.
136. Kenrick Park	Newton Street Commission.
137. Loring Park	Newton Street Commission.
138. Lower Falls Park	Newton Street Commission.
139. Hobbs Brook Storage Basin	Cambridge Water Board.
140. Adams Park	Weymouth Park Commission.
141. Ward 4 Playground	Quincy Park Commission.
142. Heath Street Lot	Brookline Park Commission.
143. Dudley Street Triangle	Brookline Park Commission.
144. Newton Street Reserve	Brookline Water Department, Street Department, and Overseers of Poor.
145. Payson Park Reservoir	Cambridge Water Board.
146. Dana Square	Cambridge Park Commission.
147. Fort Washington	Cambridge Park Commission.
148. Clifton Grove	Malden Park Commission.
149. Menotomy Rock Park	Arlington Park Commission.
150. Russell Park	Arlington Park Commission.
151. Meadow Park	Arlington Park Commission.
152. Great Meadows	Arlington Water Commission.
153. Belmont	Belmont Selectmen.
154. How Park	Watertown Park Commission.

OPEN SPACES.	CONTROLLED BY —
155. Whitney Hill Park	Watertown Park Commission.
156. Highway Lot	Watertown Highway Department.
157. Irving Park	Watertown Park Commission.
158. Knowles Delta	Watertown Park Commission.
159. Wellesley Water Works	Wellesley Water Board.
160. Maugus Hill Reservoir	Wellesley Water Board.
161. Stone Park Playground	Dedham Park Commission.
162. Hamilton Park	Hyde Park Commission.
163. Little Pond Reservation	Braintree Water Board.
164. Stand Pipe	Braintree Water Board.
165. City Park	Everett Park Commission.
166. Brooks Park	Medford Park Commission.
167. Magoun Park	Medford Park Commission.
168. Logan Park	Medford Park Commission.
169. Public Common	Medford Park Commission.
170. Governor Avenue	Medford Park Commission.
171. Hastings Park	Medford Park Commission.
172. Brooks Playstead	Medford Park Commission.
173. Prospect Hill Park	Somerville Department of Public Grounds.
174. Lincoln Park	Somerville Department of Public Grounds.
175. Playground and High-service Pumping Station.	Somerville Department of Public Grounds and Water Board.
176. Everett Avenue Park and Playground	Chelsea Park Commission.
177. Washington Park	Chelsea Park Commission.
178. Powder Horn Park	Chelsea Park Commission, Water Board and Soldiers' Home.
179. Willow Street Park	Chelsea Park Commission.
180. Leased Common	Nahant Selectmen.
181. Dover Common	Dover Park Commission.
182. Water Reservation	Needham Water Commission.
183. Ryan's Hill Standpipe	Needham Water Commission.
184. Highlandville Common	Needham Selectmen.
185. Dedham Avenue Triangle	Needham Selectmen.
186. Ward 3 Playground	Quincy Park Commission.
187. Ward 6 Playground	Quincy Park Commission.
188. Sewerage Land	Quincy Sewerage Commission.
189. Reservoir	Metropolitan Water Board.
190. Quincy Standpipe	Quincy Water Commission.
191. Pumping Station	Quincy Water Commission.
192. Ward 2 Playground	Quincy Park Commission.
193. Blaney's Beach	Swampscott Park Commission.
194. Lyman's Hill Standpipe	Brookline Water Department.

[illegible] MICH.

PUBLIC DOCUMENT . . . . No. 38.

FIFTEENTH ANNUAL REPORT

OF THE

MASSACHUSETTS BOARD OF REGISTRATION IN DENTISTRY.

FOR THE YEAR 1901.

BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
18 POST OFFICE SQUARE.
1902.

MEMBERS OF THE

MASSACHUSETTS BOARD OF REGISTRATION IN DENTISTRY,

1901.

JOHN F. DOWSLEY, D.D.S., *President,*	**Boston.**
GEORGE E. MITCHELL, D.D.S., *Secretary,*	**Haverhill.**
THOMAS J. BARRETT, D.D.S.,	**Worcester.**
DWIGHT M. CLAPP, D.M.D.,	**Boston.**
GEORGE A. MAXFIELD, D.D.S.,	**Holyoke.**

Commonwealth of Massachusetts.

BOARD OF REGISTRATION IN DENTISTRY.

To His Excellency W. MURRAY CRANE, *Governor*.

SIR: — Complying with the provision of section 6, chapter 137 of the Acts of 1887, the Board of Registration in Dentistry has the honor to present to you this its fifteenth annual report, for the year 1901.

Dwight M. Clapp, D.M.D., of Boston, and George A. Maxfield, D.D.S., of Holyoke, whose commissions expired in April, were reappointed members of this Board by Your Excellency for three years. The former organization of the Board was continued, John F. Dowsley, D.D.S., of Boston, president; and G. Everett Mitchell, D.D.S., of Haverhill, secretary.

Meetings for the examination of candidates were held this year in March, June and November. The result of these examinations is as follows: —

March: examined, 91; failed, 45; registered, 46; 61 were examined for the first time; 14, for the second time; 8, for the third time; 5, for the fourth time; 2, for the fifth time; 1, for the seventh time.

June: examined, 109; failed, 52; registered, 57; 65 were examined for the first time; 32, for the second time; 3, for the third time; 4, for the fourth time; 3, for the fifth time; 1, for the sixth time; 1, for the ninth time.

November: examined, 79; failed, 35; registered, 44; 27 were examined for the first time; 20, for the second time; 23, for the third time; 4, for the fourth time; 2, for the fifth time; 2, for the sixth time; 1, for the seventh time.

The above figures show that a considerable number of rejected applicants accept the advantage granted them under the law for re-examination. The most discouraging feature, however, is that in many cases no perceptible improvement is noticed, and it is a question in the mind of the Board whether or not the number of trials a candidate may take should not be limited by legislation.

In connection with this question of examination, the Board would earnestly recommend that the college faculties would forbid undergraduates taking the State Board examination before the end of their tuition at college, as in the majority of cases they are not fitted to pass a successful examination until they have taken their full course of study.

The influence of the work of the Board has been beneficial, in that it has given a stimulus to the teaching in the dental schools, and has induced stricter scrutiny of the acquirements of candidates for diplomas. Formerly, students often sought the schools from which they could be graduated most easily, but now they prefer those that require a high standard. The demand of the present is, and of the future will be, for higher education in this profession.

Through the efforts of the committee appointed by the Massachusetts Dental Society, and their co-operation with the State Board, eight cases of violation have been reported and prosecuted by the police authorities during the present year; in each case the offender was fined fifty dollars.

A new kind of violation has appeared, — that of physicians who seek to take advantage of section 9, — "Nothing in this act shall apply to any practising physician who is a graduate from the medical department of any incorporated college." Undoubtedly the purpose of the law in this regard is not that a medical diploma is an equivalent for the examination and certificate of registration required for the regular practice of dentistry, which would be absurd, but merely that no regular physician may be deterred from performing a dental operation or treatment of a patient whenever a case arises in his medical practice requiring immediate attention or relief. The object of this exemption, as of the law itself, is primarily the relief to the individual patient and the good of the public. In the opinion of the Board, a graduate of an incorporated college not practising *bona fide* as a physician cannot be entitled to this privilege.

The meetings of the Board for examination of candidates during 1902 will be held in Boston, March 5, 6 and 7, June 25, 26 and 27, October 22, 23 and 24. Special notice of examinations are published in the dental journals the month preceding each meeting.

A list of the dentists registered since December, 1901, is appended.

The receipts and expenditures of the Board since the last report are as follows: —

RECEIPTS.

Balance in State Treasury Jan. 1, 1901,	$1,313 62
Fees for examination March, June and November,	3,425 00
	$4,738 62

EXPENDITURES.

Expenses to Dec. 31, 1901,	3,100 98
Balance in State Treasury Dec. 31, 1901,	$1,637 64

All of which is respectfully submitted.

JOHN F. DOWSLEY, *President.*
G. EVERETT MITCHELL, *Secretary.*

DEC. 31, 1901.

ALPHABETICAL LIST OF DENTISTS

Registered by Examination since December, 1900.

March, 1901.

Abby, Thomas, Jr.,	Marblehead.
Bliss, James Francis,	Boston.
Boutwell, Leslie Barnes,	North Cambridge.
Buckley, Patrick H.,	Natick.
Carter, Ernest F.,	Waverly, N. Y.
Cox, William Alexander,	Cambridge.
Cushing, Harry Howard,	Boston.
Cutler, James W.,	Providence, R. I.
Davis, Walter Alonzo,	Cambridge.
Davis, Wendell F.,	North Acton.
Delahanty, Joseph Francis,	South Boston.
DeWager, Emmanuel Aloysious,	East Boston.
Dobson, William E.,	Waterville, Me.
Donovan, John Patrick,	Norwood.
Dort, Wilson Case,	Providence, R. I.
Fanning, Ellio Vinal,	Campello.
Freeze, Seldon H.,	Boston.
Gould, Rufus Henry,	Worcester.
Hayden, Robert Ferguson,	Cambridgeport.
Hicks, Fred B.,	Boston.
Hinckley, Frank B.,	Fall River.
Howe, Percy Rogers,	Lewiston, Me.
Jepsen, Jeppe Christian,	South Boston.
Kellogg, Chas. L.,	Orange.
Knight, Alfred Elmore,	Boston.
Loring, Burton Elmer,	Worcester.
Mayo, Edmond W.,	Orange.
McElhinney, George M.,	Ottawa, Can.
McIlvain, J. Morton,	Pawtucket, R. I.
Nichols, Woodbury F.,	Boston.
Nugent, Thomas J.,	Milford.
Owens, Thomas Barth,	Boston.

Parker, Lester,	Cambridge.
Perry, Walter L. G.,	East Boston.
Potvin, Zephir,	Baltimore, Md.
Race, Clarence Adams,	East Boothbay, Me.
Roche, John F.,	Thorndike.
Rourke, James E.,	South Boston.
Schermerhorn, Louis Y.,	Longmeadow.
Sharpe, Merton R.,	Putnam, Conn.
Smith, James Francis,	Waltham.
Spencer, James Francis,	Worcester.
Springer, Oscar M.,	Boston.
White, Emery William,	Boston.
Whitehill, Robert,	Cambridge.
Williams, Ralph H.,	Cheshire.

June, 1901.

Ames, George Henry,	Providence, R. I.
Andrews, Fenimore S.,	Fitchburg.
Armstrong, William Henry,	Springfield.
Barney, Roland Sanford,	Southborough.
Berks, Pliny Woodside,	Jamaica Plain.
Bonneville, G. W.,	Greenfield.
Brown, Fred Phillips,	Bradford.
Burbank, John Swift,	Brockton.
Carter, Farquhar D.,	Dorchester.
Cassidy, Frederick M.,	Fitchburg.
Coles, Arthur F.,	Springfield.
Coy, William Segar,	Westerly, R. I.
Crawford, Thomas A.,	South Boston.
Cronin, Charles A.,	Milford.
Davis, Walter W.,	Medford.
Eckert, John E.,	Cambridge.
FitzGibbon, Frank J.,	Springfield.
Flanagan, Joseph E.,	Worcester.
Gallahue, John J.,	South Boston.
Gillett, Henry Webster,	Newport, R. I.
Hale, Charles Wesley,	Springfield.
Hammond, Thomas Frederick,	Natick.
Harder, William T.,	Pittsfield.
Hare, Richard J.,	Ashburnham.
Heffern, Peter James,	Pawtucket, R. I.
Hubbel, Edgar G.,	Pittsfield.
Keefe, Dennis F.,	Providence, R. I.

Keith, Ivan Shearman,	Boston.
Kennedy, James T.,	Chicopee.
Ladd, Lawrence A.,	Pownal, Vt.
Leland, Henry,	Winchendon.
Locke, Maurice E.,	Brockton.
Luce, Murray F.,	Haverhill.
Luther, Henry H.,	Jamestown, R. I.
Maguire, William E.,	Wales.
Mann, Albert E.,	Brantford, Ontario, Can.
McCarthy, Stephen D.,	South Boston.
Mitchell, Matthew J.,	Taunton.
McMurray, Albert T.,	Cambridge.
O'Brien, James J.,	Somerville.
Pike, Charles G.,	Dorchester.
Pittinger, Lee R.,	Boston.
Proctor, Charles M.,	Malden.
Reoch, Norman G.,	Phœnix, R. I.
Reinstein, Irving O.,	Roxbury.
Shepard, Luther D., Jr.,	Brookline.
Shinn, Paul H.,	Cambridge.
Shipman, William L.,	Worcester.
Smith, Harry J.,	Cottage City.
Thomson, Hugo S.,	Canaan, Conn.
Witbeck, Edna Ruth,	New York.
Woodbridge, Harold F. G.,	Boston.
Kelley, Zenas C.,	Lynn.

November, 1901.

Banks, Geo. Herbert,	Guilford, Conn.
Bradlee, Leonard M.,	Mattapan.
Brown, Fred L. S.,	Westborough.
Bruce, Adelbert M.,	Boston.
Clifford, William J.,	Worcester.
Cousens, Frank B.,	Jamaica Plain.
Cummings, Guy A.,	Ware.
Cunningham, Arthur W.,	Taunton.
Fison, Harry K.,	Peace Dale, R. I.
Ford, Thomas A.,	Hopkinton.
Fox, Edward T.,	Clinton.
Gallup, Julius C., Jr.,	Boston.
Hall, Ernest L.,	Bridgeton, Me.
Hall, Frederick G.,	Boston.
Hewson, Eddie L. W.,	Malden.

Jones, Harry P.,	**Norway, Me.**
Jordan, Llewellyn W.,	**Mattapan.**
Keenan, William J.,	**Cambridge.**
Ladd, Fred E.,	**Brockton.**
Langis, H. E.,	**Fall River.**
Leith, George W.,	**Lowell.**
Lockhart, James P.,	**Cambridge.**
MacVicar, Archibald,	**Lynn.**
Mead, Frank H.,	**Bridgeton, Me.**
McGourty, Edward T.,	**Worcester.**
Newell, Walter G.,	**South Hingham.**
Payzant, E. R.,	**Taunton.**
Putnam, Clinton A.,	**Lewiston, Me.**
Rice, Albert C.,	**Northampton.**
Roberts, W. N.,	**Rockville, Conn.**
Robinson, H. Sanford,	**Powling, N. Y.**
Simon, Ralph W.,	**Boston.**
Smith, Clarence E.,	**Warren.**
Smith, Geo. A.,	**Lynn.**
Smith, Howard F.,	**South Hadley Falls.**
Soule, Harmon B.,	**Bakersfield, Vt.**
Spears, William J.,	**Newport, R. I.**
Stone, Ella F. Stroelin,	**Provincetown.**
Sullivan, Eugene E.,	**Worcester.**
Sykora, Rudolf,	**Boston.**
Thayer, John Phillips,	**Boston.**
Van Derpool, George,	**Troy, N. Y.**
Washburn, David L.,	**Natick.**
Watkins, Henry E.,	**Worcester.**

PUBLIC DOCUMENT . . . . No. 39.

SIXTEENTH ANNUAL REPORT

OF THE

MASSACHUSETTS BOARD OF REGISTRATION IN PHARMACY,

FOR THE YEAR 1901.

BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
18 POST OFFICE SQUARE.
1902.

Commonwealth of Massachusetts.

REPORT.

To His Excellency W. MURRAY CRANE, *Governor.*

SIR: — In compliance with the requirements of section 4, chapter 397, Acts of 1896, we hereby submit to Your Excellency our sixteenth annual report. We are pleased to note that from a commercial stand-point the condition of pharmacy in the State is greatly in advance of one year ago. Industry and commerce go hand in hand, and to industrial prosperity is due the commercial prosperity throughout the State. No business in existence is so disturbed by cut-rate competition as is pharmacy; but the public is learning that cheap prices mean cheap goods, and this class of competition is becoming less formidable than formerly.

Another cause for congratulation among druggists is the repeal of the war stamp tax that took effect July 1 of this year. The national revenue from the tax on drug store products was $5,000,000 per annum.

The professional side of pharmacy advances slowly, but the demand of the present is, and of the future will be, for higher education in this profession. The excellent schools of pharmacy in this country offer a means for obtaining this education. In former reports of this Board, attention has been called to the desirability of a higher educational standard for those entering the drug business. The results of our examinations show that this point cannot be too strongly emphasized.

PRACTICAL EXAMINATIONS.

Commencing January 1 of this year, the character of examinations of candidates for registration has been radically changed. Prior to that time the examination consisted of written and oral questions and the identification of drugs. We have now a well-equipped prescription counter, where each candidate is required to dispense as many prescriptions as time will allow. This cannot be satisfactorily done without actual drug store experience. The oral examination consists practically of questions relating to the preparation of official products and prescription reading. The written examination is more technical in character, but is confined to questions of practical value to the professional pharmacist. It is felt by the Board that with this form of examination the practical, useful knowledge of the applicant is more readily determined than by the older method. It is no longer possible for persons to pass the Board examinations by learning questions and answers, or by the employment of quiz instructors; and it is a waste of time to appear before the Board without systematic study and prescription counter experience.

LIQUOR CERTIFICATES.

The granting of liquor certificates is an important duty of the Board. Section 11 of the "Act to regulate the practice of pharmacy" reads as follows: —

> The state board of registration in pharmacy may issue to applicants for licenses of the sixth class to sell intoxicating liquors a certificate, which shall not be valid after the expiration of one year from its date, stating that in the judgment of said board he is a proper person to be intrusted with such license, and that the public good will be promoted by the granting of said license.

It is further stated, in section 10 of the above-mentioned act, —

> if it shall appear that the applicant is a fit person to receive such license . . . and is a registered pharmacist actively engaged in business on his own account.

Three qualifications are to determine the granting of these certificates; namely, the public good, fitness of the person and proprietorship. In some sections there is an excessive influx of new drug stores demanding sixth-class licenses. It is the belief of this Board that it should not, by granting of certificates, encourage the multiplication of stores to such an extent that the sale of intoxicating liquor becomes a necessity to the maintenance of stores in those vicinities. It is the intent of the Board to be impartial and fair to all concerned in this part of its work.

ENFORCEMENT OF THE PHARMACY LAWS.

In this department, the Board, with the assistance of its agent, has endeavored to investigate all complaints that have come to its notice. A larger number of complaints has come to us than in the preceding year, and some of an aggravated character. It should be said, however, that a large number of those against whom complaint has been made were unregistered persons, engaged in the drug business.

RE-REGISTRATION.

There has been a demand by the State Pharmaceutical Association and by individuals for a correct list of the registered pharmacists of the State. This can be had only by re-registration. Since the enactment of the pharmacy law in 1885 to this date there have been 4,029 pharmacists registered in this State; many of these have died; others have left the State or discontinued business. There are at present 1,568 drug stores in the State; possibly one-third of these employ registered clerks; this accounts for about one-half of the total number, leaving about 2,000 certificates of registration unaccounted for. These latter certificates may be, and have been in known instances, used illegally by being exposed in stores of questionable character in which no registered man is employed. This Board is unanimously of the opinion that some provision should be made for re-registration at stated periods. Such provision is made in twenty-nine States in the Union. In twenty-five States annual, in two States biennial and in one State triennial re-registration is required; the fees in these States range from 50 cents to $5 per annum. This Board recommends that the pharmacy laws be amended to the effect that re-registration be required biennially, and that the fee therefor shall be $1, sufficient to cover expenses incurred.

LEGISLATION.

Referring again to sections 10 and 11 of the pharmacy laws, quoted above, it will be seen that licenses of the sixth class can be granted only to "a registered pharmacist actively engaged in business on his own account." Section 12 of the pharmacy act provides that sixth-class licenses shall remain in force in "cases where the registered pharmacist has died or become incapacitated, and his business is conducted by his widow, executor or administrator, under a registered pharmacist;" but there is no provision for the renewing of a license on May 1 to the widow, executor or administrator or to the registered clerk. In many instances it has become a financial injury to widows of deceased pharmacists. We therefore recommend that section 18 of chapter 397 of the Acts of 1896, as amended by chapter 317 of the Acts of 1900, be further amended as follows: —

Section eighteen of chapter three hundred and ninety-seven of the acts of the year eighteen hundred and ninety-six, as amended by chapter three hundred and seventeen of the acts of nineteen hundred, is hereby further amended by adding after the word "pharmacist," in the last line, the following words: — "who may also be considered qualified to receive a sixth-class license to be exercised upon said premises of said deceased or incapacitated pharmacist under the registered licensee's personal supervision. The provisions of section ten of chapter three hundred and ninety-six of the acts of the year eighteen hundred and ninety-six, inconsistent herewith, shall not apply,"— so as to read as follows: — *Section 28.* Whoever not being registered as aforesaid shall retail, compound for sale or dispense for medicinal purposes, or shall keep or expose for sale, drugs, medicines, chemicals or poisons, except as provided in section twenty-three of this act, shall be punished by a fine not exceeding fifty dollars. But nothing in this act shall be construed to prohibit the employment of apprentices or assistants under the personal supervision of a registered pharmacist. In cases where a registered pharmacist has died or become incapacitated, his business may be continued by his widow, executor or administrator, under a registered pharmacist, who may also be considered qualified to receive a sixth-class license to be exercised upon said premises of said deceased or incapacitated pharmacist under the registered licensee's personal supervision. The provisions of section ten of chapter three hundred and ninety-six of the acts of the year eighteen hundred and ninety-six, inconsistent herewith, shall not apply.

With this report the term of office of Mr. John A. Rice expires by limitation of law after serving for ten years as a member of this Board. The remaining members of the Board and the druggists of the State will remember him as a man of good judgment, strong convictions and kindly nature. The State has had no more conscientious servant than he. In signing this report, it is understood that Mr. Rice does not necessarily endorse these sentiments.

It will be seen that the expenses of the Board for the year have been less than anticipated. This was due to the fact that the member from the western part of the State has been able to attend but three meetings during the year, and that another member was unable to attend for nearly two months.

With the old method of examination the Board was able to examine fifteen per day; with the new method, but ten can be examined. This makes a greater number of examination days necessary, and thereby increases the expense. Had all of the members been present through the year, as usual, the appropriation for the year would have been fully expended. For the year ending Oct. 1, 1900, twenty-three days were required for examinations; for this year, thirty-six days.

The report of the secretary and the report of the agent of the Board are appended hereto.

C. F. NIXON, *President*.
AMOS K. TILDEN, *Secretary*.
F. H. BUTLER.
JOHN A. RICE.
GEO. M. HOYT.

BOSTON, MASS., Oct. 1, 1901.

SECRETARY'S REPORT.

EXAMINATION ACCOUNT.

Meetings for examinations have been held on dates and with results as follows: —

1900-1901.	Days.	Examined.	Registered.	Rejected.
October 2-3,	2	25	3	22
November 14-15,	2	29	3	26
December 12,	1	13	2	11
January 1-2,	2	19	6	13
January 29-30,	2	17	5	12
February 5,	1	10	2	8
February 12,	1	9	3	6
February 20-21,	2	18	3	15
February 27-28,	2	17	6	11
March 12,	1	10	3	7
March 21,	1	10	4	6
March 28,	1	8	4	4
April 9-10,	2	18	3	15
April 17,	1	10	–	10
April 30,	1	8	1	7
May 7,	1	10	–	10
May 15,	1	10	–	10
May 22,	1	8	2	6
May 27-28,	2	21	1	20
June 5-6,	2	20	7	13
June 11,	1	10	2	8
June 18-19-20,	3	30	8	22
September 17,	1	8	1	7
September 23-24,	1	12	2	10
September 30,	1	8	2	6
Totals,	36	358	73	285

Of the seventy-three certificates granted this year: —

13 passed on first examination.
19 " " second "
17 " " third "
8 " " fourth "
7 " " fifth "
3 passed on sixth examination.
3 " " ninth "
2 " " eleventh "
1 " " fifteenth "

FINANCIAL STATEMENT FROM OCT. 1, 1900, TO OCT. 1, 1901.

Oct. 1, 1900, cash in State treasury,		$501 88
Received during the year: —		
Fees from applicants, 264 at $3,	$792 00	
Fees from applicants, 119 at $5,	595 00	
For duplicate certificates,	8 00	
		1,395 00
Total,		$1,896 88
Returned to family of W. A. E. Kimball, he having died a few days after sending the money,		5 00
		$1,891 88

Expenditures.

	Services.	Expenses.	Total.	
C. F. Nixon, president,	$235 00	$114 35	$349 35	
A. K. Tilden, secretary,	232 50	25 47	257 97	
A. K. Tilden (miscellaneous bills),	–	30 34	30 34	
F. H. Butler,	150 00	53 80	203 80	
F. H. Butler (printing),	–	3 00	3 00	
John A. Rice,	15 00	30 66	45 66	
G. M. Hoyt,	222 50	58 70	281 20	
G. M. Hoyt, drugs,	–	3 60	3 60	
	$855 00	$319 92	$1,174 92	
Hammett School Supply Company,		$3 75		
Wright & Potter Printing Company,		15 01		
E. L. Patch Company,		4 78		
Weeks & Potter Company,		9 34		
Theo. Metcalf Company,		2 65		
			35 53	
				1,210 45
Balance in State treasury,				$681 43

Liabilities.

Applicants not examined, fees paid: —			
Prior to Oct. 1, 1900: —			
48 at $3,	$144 00		
45 at $5,	225 00		
		$369 00	
From Oct. 1, 1900, to Oct. 1, 1901: —			
37 at $3,	$111 00		
20 at $5,	100 00		
		211 00	
			$580 00

APPLICATIONS FOR CERTIFICATES OF FITNESS.

Applications received from Oct. 1, 1900, to March 1, 1901, to expire April 30, 1901,		55
Certificates granted,	35	
Applications refused,	20	
Applications received from March 1, 1901, to Oct. 1, 1901, to expire April 30, 1902,		1,207
Certificates granted,	1,104	
Applications refused,	98	
Applications transferred,	5	
Total number of applications for the year,		1,262
Total number of certificates granted,	1,139	
Total number of applications refused,	118	
Total number of applications transferred,	5	
Total amount of fees received,		$1,262 00
Returned to rejected applicants,	$118 00	
Paid to State Treasurer,	1,139 00	
Transferred,	5 00	

FINANCIAL STATEMENT FROM OCT. 1, 1900, TO OCT. 1, 1901.

	Services.	Expenses.	Total.
C. F. Nixon, president,	$352 50	$197 75	$550 25
C. F. Nixon, supplies,	–	11 29	11 29
A. K. Tilden,	897 50	33 01	930 51
A. K. Tilden, supplies, etc.,	–	41 95	41 95
F. H. Butler,	107 50	36 47	143 97
G. M. Hoyt,	90 00	29 75	119 75
G. M. Hoyt, supplies,	–	31 71	31 71
S. B. Harris, agent,	780 00	366 94	1,146 94
Lucie Barret Koch,	570 00	–	570 00
Bessie Burroughs,	50 00	–	50 00
	$2,847 50	$748 87	$3,596 37

J. L. Fairbanks Company,	$6 60
Wright & Potter Printing Company,	71 34
Thorp & Martin Company,	6 75
Press Clipping Bureau,	21 75
N. E. Telegraph and Telephone Company,	11 67
Fox, Fultz & Co.,	5 18
E. L. Patch Company,	76 75
Fuller, Leonard & Small,	17 50
Charles P. Whittle,	325 00
Wm. H. Bradford,	7 21
Whitall, Tatum Company,	198 94

Burditt & Williams Company,	$17 00		
Spatula Publishing Company,	3 00		
Weeks & Potter,	4 52		
Theo. Metcalf Company,	3 05		
Sampson, Murdock Company,	5 50		
		$781 58	
			$4,377 95

Number of meetings held for granting to applicants certificates of fitness,	18
Number of hearings on applications for certificates of fitness,	67

ENFORCEMENT OF PHARMACY LAW.

SUMMARY.

Number of meetings for enforcement of pharmacy law,	18
Number of hearings on violations of pharmacy law,	25
Number of certificates suspended for ten years,	1
Number of certificates suspended for five years,	1
Number of certificates suspended for two years,	3
Number of certificates suspended for one year,	6
Number of certificates suspended for eighteen months,	1
Number of certificates suspended for two months,	2
Number of cases continued for sentence,	1
Number of formal complaints to the Board,	31

FINANCIAL STATEMENT FROM OCT. 1, 1900, TO OCT. 1, 1901.

	Services.	Expenses.	Total.	
C. F. Nixon,	$37 50	$21 00	$58 50	
A. K. Tilden,	50 00	4 75	54 75	
A. K. Tilden, witness fees,	–	75 90	75 90	
F. H. Butler,	47 50	20 07	67 57	
G. M. Hoyt,	47 50	15 70	63 20	
S. B. Harris,	795 00	368 31	1,163 31	
	$977 50	$505 73	$1,483 23	
J. L. Fairbanks & Co.,		$9 70		
Press Clipping Bureau,		2 00		
			11 70	
Total,				$1,494 93

AMOS K. TILDEN,

Secretary.

AGENT'S REPORT.

To the Board of Registration in Pharmacy.

Herewith submitted is a condensed report of my doings under your orders during the past year, with a résumé of various matters which have come under my observation in the performance of my official duties which relate to the condition of pharmacy, together with records relating to the enforcement of the pharmacy laws of this Commonwealth.

The following registered pharmacists died during the year: —

Bourne, Jacob F.,	Boston.
Buffington, Elisha D.,	Worcester.
Coville, Frank O.,	Winchester.
Curtis, John W.,	Hinsdale.
Duval, Edmond P.,	Leominster.
Eaton, Charles I.,	Boston.
Ferguson, William A.,	Foxborough.
Hartshorn, Fred'k A.,	Marlborough.
Hodges, Chauncey A.,	Lynn.
Hollis, Francis,	Boston.
Jenkins, Luther L.,	Boston.
Mahern, John J.,	Woburn.
McCarthy, Callahan,	Northbridge.
Nash, Frank S.,	Brockton.
O'Brien, James,	Lowell.
Ohlander, John V.,	Worcester.
Reid, Charles S.,	Holbrook.
Robbings, George H.,	West Warren.
Shay, Thomas E.,	Salem.
Sweeney, John P.,	Boston.
Toward, Arlie B.,	Boston.
Wetherell, Monson L.,	Gloucester.
Williams, Joseph,	Newburyport.

In the above list will be recognized the names of several druggists who were long and favorably known in the pharmacy business.

My duties have taken me into every portion of the State. It has been the general expression from those engaged in the profession that their business during the year 1901 has been more satisfactory than in 1900, which is gratifying.

It is somewhat humiliating to report that during the year more prosecutions have been made and more convictions of violators of the pharmacy law than during the previous year. The reason is apparent why prosecutions have increased. Of the number arraigned before the court, a large per cent. were unregistered pharmacists. In several instances they had formerly been engaged in the liquor business in cities and towns where licenses had formerly been granted, but failing to grant licenses by reason of the "no" vote, and knowing full well that licenses of the sixth class may be granted where the "no" vote prevails, they took it upon themselves to employ a registered clerk and open up to all appearances a full-fledged pharmacy; but have been obliged to settle with our courts for their folly, the law having been repealed whereby formerly unregistered proprietors could conduct the business of pharmacy with a registered clerk, which has proven quite an obstacle to their advancement as druggists. The majority of those who have thus embarked have wisely given up the undertaking. In one instance four men engaged in the business, one being registered; prosecution was followed by arrest, accompanied with bailing process. The three unregistered men fled to Canada, and were defaulted in court. It may be confidently believed that they will not come under the supervision of the Board again.

Another violator, known to the Board, having been repeatedly prosecuted and convicted, upon another seizure being made at his place of business, made quick time and crossed the border line. He likewise will not give the Board or the local authorities any further trouble.

Another, who advertised himself as general manager of several drug stores, the proprietor not being registered, after being severely disciplined, concluded to interest himself as manager of a travelling band of gypsies.

Another would-be druggist, unregistered, who has been repeatedly convicted for violating the liquor law and pharmacy law, and has paid fines and served time in the jail, upon learning that another indictment had been found against him, hurriedly left the State. At the time of his departure he was owner of three drug stores in Massachusetts. They have all been closed.

The public good is subserved and the pharmacy business elevated by these departures, and for the benefit of those who may be inclined without the proper qualifications prescribed by law to enter into the drug business to evade the liquor law, it seems proper to say: You have no right to take the responsibility upon yourselves to deal in drugs, medicines, chemicals and poisons, thereby jeopardizing the public welfare, that you may, under a respectable cover, conduct an unlawful, disreputable business. Never sail under false colors. If you are inclined to engage in the liquor business, do so, if at all, under the sanction of a liquor license. Don't attempt to do so as a pharmacist in this Commonwealth.

Chapter 106, Acts of 1900, amended section 10 of chapter 397 of the Acts of 1896 by adding at the end thereof the following: —

> A registered pharmacist who owns stock to the actual value of at least five hundred dollars in a company incorporated for the purpose of carrying on the drug business, and who conducts in person the business of a drug store of such corporation, shall be considered as actively engaged in business on his own account within the meaning of this act, and may be considered qualified to receive such a license for said store.

Whereas the above statute is all right when resorted to by honest men, who organize stock companies under its provision and honestly conform to the law, and the public welfare will not suffer thereby, evil-disposed persons have taken advantage of its provisions, organized stock companies under the laws of other States, present or pretend to give stock to registered persons of the value of five hundred dollars, as estimated by the promoters, then the drug store opens up with a registered man, a figure head in the venture, the combination bringing incompetency into the business.

Your agent, as the Board well knows, has been called upon to investigate several such cases. Perhaps it is not out of place to give one illustration.

In the city of Boston complaint came to the Board that a drug store, giving name and location, was open for business without the proprietor being registered, a registered man calling occasionally. Upon investigation the proprietor said: —

"This is a stock company, organized under the laws of Maine. Mr. —— is the registered clerk, who comes here when he is wanted. He is one of the stockholders in the company. We are not quite satisfied with him. We are going to get another registered man."

In the course of time another registered man put in an appearance. Upon being interviewed by your agent as to his connection with the store, he said: —

"This is a stock company, I understand. The treasurer of the company has made out a certificate of stock in my name, claiming to be worth five hundred dollars, and put it in the money drawer, saying, 'In the event of any person questioning you as to your ownership in the store, show this certificate of stock to them.'"

He further stated: "I did not put any money into the concern; I don't claim to own the certificate of stock; all the interest I claim to have in this store is my weekly wages."

This was the confession of a truthful man. When informed in regard to the law, he said, "I shall take my certificate and leave." The store has ceased to do business in this Commonwealth.

Investigation of several cases of a similar character proved that incompetent persons have taken advantage of this statute, thereby imposing upon the public.

In the performance of my duties, my attention has been called to the fact that in several towns voting no license, licenses of the sixth class have been granted by the selectmen and issued to druggists without the licensee giving any bond therefor, — notwithstanding that section 13, chapter 100 of the Public Statutes, distinctly declares, in the following language: —

> No license shall be issued until the license fee has been paid to the treasurer of the city or town by which it is to be issued and until he has received a satisfactory bond, payable to him as such treasurer, in the sum of one thousand dollars, signed by the licensee and sufficient surety or sureties, who shall be jointly and severally liable and conditioned for the payment of all costs, damages and fines incurred by violation of the provisions of this chapter. Separate suits may be brought on such bond by any persons at their own expense. Such bond, after approval, shall be filed in the office of the city or town clerk, and may be sued in any court having jurisdiction under the provisions of this chapter, and a certified copy thereof shall be admissible in evidence, and shall have the same force and effect as the original bond would have if offered in evidence. The bond to be taken in each case may be in the following form.

Subsequently follows the form of bond required.

Upon calling the attention of the selectmen to this violation of the statute, they have immediately taken steps to conform to the law governing the same.

Section 1, chapter 431, Acts of 1887, reads as follows: —

> No license, except of the sixth class named in section ten of chapter one hundred of the Public Statutes, shall be hereafter granted to retail druggists or apothecaries for the sale of spirituous or intoxicating liquor.

Notwithstanding this plain declaration of the statutes, instances have come to my knowledge where the granting authorities have taken upon themselves the responsibility of issuing licenses of the first and fourth classes to druggists in this Commonwealth, thereby violating the license law and affording no protection to the licensee whatever.

During the past year an unusual number of drug stores have changed proprietors, — in many instances, men of long standing in the business retiring, to be succeeded by younger pharmacists, which has had the tendency to infuse younger blood into the profession.

Recapitulation.

Number of druggists deceased,	23
Number of drug stores in the Commonwealth,	1,568
Number of drug stores closed,	36
Number of new stores opened for business,	30
Number of stores found with unregistered proprietors and no registered partners,	23
Number of complaints made to the Board and investigated,	101
Number of complaints investigated and reported to the proper prosecuting officers,	86
Number of prosecutions,	75
Number of convictions,	61
Number of continued cases in court,	9
Number found not guilty,	5
Amount of fines paid,	$4,140
Number sent to jail,	2
Number of formal complaints made to the Board,	31

My thanks are hereby extended to the various local authorities throughout the Commonwealth for assistance rendered to me in the discharge of my official duties.

Respectfully submitted,

SIMON B. HARRIS,
Agent.

LAWS

RELATING TO

THE PRACTICE OF PHARMACY

IN

MASSACHUSETTS.

1901.

LAWS RELATING TO PHARMACY.

[Chapter 397, Acts of 1896, as amended by the Acts of 1898, 1899, 1900 and 1901.]

An Act to regulate the Practice of Pharmacy.

Be it enacted, etc., as follows:

Section 1. The board of registration in pharmacy shall consist of five persons. The appointments to fill vacancies occurring from expiration of terms of office shall be for five years from the first day of October, in each year, and no person shall hereafter serve as a member of said board for more than five years, consecutively,— providing that the present members of said board shall continue to hold their offices during the terms for which they were severally appointed. The appointments to said board shall be made by the governor with the advice and consent of the council, and only skilled pharmacists, resident in the Commonwealth, who have had ten consecutive years of practical experience in the compounding and dispensing of physicians' prescriptions and actively engaged in the drug business, shall be eligible, and not more than one member of said board shall be interested in the sale of drugs, medicines and chemicals and the compounding and dispensing of physicians' prescriptions in the same councillor district. Any member of said board may be removed from office for cause by the governor.

Section 2. The members of said board shall meet on the first Tuesday of October in each year at such time and place as they may determine, and shall immediately proceed to organize by electing a president and secretary, who shall be members of the board, and who shall hold their respective offices for the term of one year. The secretary shall give to the treasurer and receiver general of the Commonwealth a bond with sufficient sureties, to be approved by the governor and council, for the faithful discharge of the duties of his office. The said board shall hold three regular meetings in each year, one on the first Tuesday of January, one on the first Tuesday of May and one on the first Tuesday of October, and such additional meetings at such times and places as they shall determine.

Section 3. The compensation, incidental and travelling expenses of the board shall be paid from the treasury of the Commonwealth.

The compensation of the members of the board shall be five dollars each for every day actually spent in the discharge of their duties and the amount actually paid by them for necessary travelling expenses in attending the meetings of the board, but in no case exceeding three cents per mile each way. The bills for such compensation and their incidental and travelling expenses shall be approved by the board and sent to the auditor of the Commonwealth, who shall certify to the governor and council the amounts due as in case of other bills and accounts approved by him under the provisions of law. So much of the receipts from examinations as may be necessary for the compensation and expenses of the board, as aforesaid, is hereby appropriated, in addition to any amount authorized by the legislature for the purposes of this act.

Section 4. The board shall keep a record of the names of all persons examined and registered hereunder, and a record of all moneys received and disbursed by said board, a duplicate of which records shall always be open to inspection in the office of the secretary of the Commonwealth. Said board shall make to the governor on or before the first day of January in each year a report stating the condition of pharmacy in the state, with a full and complete record of all its official acts during the year, and the receipts and disbursements of the board.

Registration of Pharmacists.

Section 5. Any person desiring to do business as a pharmacist shall, upon payment of a fee of five dollars, be entitled to examination, and if found qualified shall be registered as a pharmacist, and shall receive a certificate signed by the president and secretary of said board.

Any person may be re-examined after the expiration of three months at any regular meeting of the board, upon the payment of a fee of three dollars. All fees received by the board under this act shall be paid by the secretary of the board into the treasury of the Commonwealth.

Section 6. Every person who has received a certificate of registration from the board shall conspicuously display the same in his place of business.

Section 7. Said board shall hear all applications by registered pharmacists for the granting of sixth class licenses, whenever such hearing is required by the applicant, and all complaints made to them against any person registered as a pharmacist, charging him with suffering or permitting the use of his name or his certificate of registration by others in the conduct of the business of pharmacy when he himself is not the owner and actively engaged in such business;

engaging in, aiding or abetting the violation or, in his business as a pharmacist, violating any of the laws of the Commonwealth now under the supervision of the board of registration in pharmacy, and especially the laws relating to the sale of intoxicating liquor. Such complaint shall be under oath, shall set out the offence alleged, and shall be made within fifteen days of the date of the act complained of.

SECTION 8. Said board shall notify the person complained against of the charge made against him and of the time and place when and where the matter will be heard by them. He may then and there appear before the board with his witnesses and be heard by counsel. Any three of the members of the board shall be a quorum for such hearing. Either member of the board may administer oaths to the witnesses at such hearing, and any person so sworn who wilfully swears or affirms falsely respecting any matter upon which his testimony is required shall be deemed guilty of perjury. Said board shall have the power to send for persons and compel the attendance of witnesses at said hearings, by process duly served.

SECTION 9. If the full board sitting at such hearing shall find that the person complained against is guilty of the acts charged against him said board may suspend his registration as a pharmacist and his certificate thereof, for such term as the board in their judgment, after due consideration of the facts, may deem for the best interest of the public, but the license or certificate of registration of a registered pharmacist shall not be suspended for a cause punishable by law until after conviction by a court of competent jurisdiction. [Amended by chapter 522, Acts of 1901, as follows: Section nine of chapter three hundred and ninety-seven of the Acts of the year eighteen hundred and ninety-six is hereby amended by striking out in the seventh line, the words "or may revoke it altogether", and in the ninth line, the words "or revoked."]

SECTION 10. No license for the sale of spirituous or intoxicating liquors, except of the sixth class, shall be granted to retail druggists or apothecaries. One or more such licenses shall be granted annually by the board of license commissioners of cities, the board of police of the city of Boston, or the selectmen of towns, to retail druggists or apothecaries, if it shall appear that the applicant is a fit person to receive such license, is not disqualified to receive the same under section sixteen of this act, and is a registered pharmacist actively engaged in business on his own account, and if he shall also present to the licensing board a certificate of fitness as provided in section eleven of this act. Retail druggists and apothecaries shall not be subject to the second clause of section nine of chapter one hundred of the Public Statutes when the sale is made, as hereinafter provided, upon the prescription of a physician. [Amended by chapter 106, Acts of 1900, as follows: Section ten of chapter three hundred and ninety-seven of the acts of the year eighteen hundred and ninety-six is hereby amended by adding at the end thereof the following: — A registered pharmacist who owns stock to the actual value of at least five hundred dollars in a company incorporated for the purpose of carrying on the drug business and who conducts in person the business of a store of such corporation, shall be considered as actively engaged in business on his own account within the meaning of this act, and may be considered as qualified to receive such a license for said store.]

Section 11. The state board of registration in pharmacy may issue to applicants for licenses of the sixth class to sell intoxicating liquor a certificate, which shall not be valid after the expiration of one year from its date, stating that in the judgment of said board he is a proper person to be entrusted with such license and that the public good will be promoted by the granting of said license. Any registered pharmacist against whom no complaints have been made to said board may be considered a proper person to receive such certificate. Such complaints shall be in writing, specifying the reason, if any, why a certificate should be withheld. For each certificate so granted by the board of registration in pharmacy said board shall be entitled to receive a fee not exceeding one dollar, to be paid by the applicant.

Section 12. Any license for the sale of intoxicating liquor, of the sixth class, shall become null and void, without any process or decree, whenever the registered pharmacist to whom it has been granted shall cease to conduct his business in person and on his own account, or upon the revocation of his registration as such pharmacist and of his certificate thereof, excepting cases where the registered pharmacist has died or become incapacitated, and his business is continued by his widow, executor or administrator, under a registered pharmacist.

Section 13. Sales of intoxicating liquor of any kind by retail druggists and apothecaries, for medicinal, mechanical or chemical purposes, shall be made only upon the certificate of the purchaser, which certificate shall state the use for which the same is wanted, and shall be immediately cancelled at the time of such sale in such manner as to show the date of cancellation.

Section 14. [Amended by chapter 91, Acts of 1901, as follows: Section fourteen of chapter three hundred and ninety-seven of the acts of the year eighteen hundred and ninety-six is hereby amended by striking out the words "who shall also sign his name in said book as part of said entry", in the fourth and fifth lines, by striking out the words "Signature of Purchaser", in the form appended to said section, and by adding at the end of said section the words: — The certificate mentioned in section thirteen of this act shall be a part of the said book and shall not be detached therefrom, and shall be in form substantially as follows: —

CERTIFICATE.

I wish to purchase,____________________________________
and I certify that I am not a Minor and that the same is to be used for * Mechanical * Chemical * Medicinal purposes. [* *Draw a line through the words which do not indicate the purpose of the purchase.*]

○ Signature____________________

Cancelled,____________________

so as to read as follows: — *Section 14.* A book shall be kept by every retail druggist and apothecary in which he shall enter at the time of every such sale the date thereof, the name of the purchaser, the kind, quantity and price of said liquor, the purpose for which it was sold, and the residence by street and number, if there be such, of said purchaser. If such sale is also made upon the prescription of a physician the book shall also contain the name of the physician and state the use for which said liquor is prescribed and the quantity to be used for such purpose, and shall be cancelled in the manner before provided with reference to certificates. Said book shall be in form substantially as follows: —

Date.	Name of Purchaser.	Residence.	Kind and Quantity.	Purpose of Use.	Price.	Name of Physician.

The certificate mentioned in section thirteen of this act shall be a part of the said book and shall not be detached therefrom, and shall be in form substantially as follows: —

CERTIFICATE.

I wish to purchase____________________________________
and I certify that I am not a Minor and that the same is to be used for * Mechanical * Chemical * Medicinal purposes. [* *Draw a line through the words which do not indicate the purpose of the purchase.*]

○ Signature____________________

Cancelled,____________________]

SECTION 15. The book, certificates and prescriptions before provided for or referred to, shall at all times be open in the city of Boston to the inspection of the board of police, and in all the cities and towns in the Commonwealth to the inspection of the mayor and aldermen, board of license commissioners, selectmen, overseers of the poor, sheriff, constables, police officers, and justices of the peace.

SECTION 16. Any person making or issuing a false or fraudulent certificate or prescription referred to in sections thirteen or fourteen of this act may be prosecuted therefor, and upon conviction may be fined ten dollars. Any retail druggist or apothecary violating any of the provisions of sections thirteen, fourteen and fifteen of this act shall, upon conviction thereof, be punished by fine of not less than fifty nor more than five hundred dollars, or imprisonment for not less than one month nor more than six months, or by both such fine and imprisonment. He shall in addition to said penalties forfeit his license and be disqualified to hold a license for the period of one year after his conviction, and if the licensee is the owner of the premises no license shall be exercised on the premises described in the forfeited license during the residue of the term thereof.

SECTION 17. Any person not being a registered pharmacist who shall procure a sixth class license for the sale of intoxicating liquors, in the name of a registered pharmacist who is dead, or in the name of a registered pharmacist by borrowing, hiring or purchasing the use of his certificate, and who, being himself the owner or manager of the place, shall by himself or his servants sell intoxicating liquor, shall upon conviction thereof be fined not less than fifty dollars nor more than five hundred dollars, and imprisoned in the house of correction for a term of not less than one month nor more than six months, and the provisions of section eight of chapter two hundred and fifteen of the Public Statutes shall not apply to such sentence.

SECTION 18. [Amended by chapter 317, Acts of 1900, as follows: Section eighteen of chapter three hundred and ninety-seven of the acts of the year eighteen hundred and ninety-six is hereby amended by striking out the words "by himself or his agent or servant, unless such agent or servant is so registered," in the second and third lines, and by adding at the end of said section the words: — In cases where a registered pharmacist has died or become incapacitated, his business may be continued by his widow, executor or administrator, under a registered pharmacist, — so as to read as follows: — *Section 18.* Whoever not being registered as aforesaid shall retail, compound for sale or dispense for medicinal purposes, or shall keep or expose for sale, drugs, medicines, chemicals or poisons, except as provided in section twenty-three of this act, shall be punished by a fine not exceeding fifty dollars. But nothing in this act shall be construed to prohibit the employment of apprentices or assistants under the personal supervision of a registered pharmacist. In cases where a registered pharmacist has died or become incapacitated, his business may be continued by his widow, executor or administrator, under a registered pharmacist.]

SECTION 19. Whoever fraudulently adulterates, for the purpose of sale, any drug or medicine, or sells any fraudulently adulterated drug or medicine, knowing the same to be adulterated, shall be punished by imprisonment in a jail not exceeding one year, or by fine not exceeding four hundred dollars; and such adulterated drugs and medicines shall be forfeited, and destroyed under the direction of the court.

SECTION 20. Whoever sells arsenic (arsenious acid), atropia or any of its salts, chloral, hydrate, chloroform, cotton root and its fluid extract, corrosive sublimate, cyanide of potassium, Donovan's solution, ergot and its fluid extract, Fowler's solution, laudanum, McMunn's elixir, morphia or any of its salts, oil of pennyroyal, oil of savin, oil of tansy, opium, Paris green, Parson's vermin exterminator, phosphorus, prussic acid, "rough on rats", strychnia or any of its salts, tartar emetic, tincture of aconite, tincture of belladonna, tincture of digitalis, tincture of nux vomica, tincture of veratrum viride, or carbolic acid, without the written prescription of a physician, shall keep a record of such sale, the name and quantity of the article sold, and the name and residence of the person or persons to whom it was delivered, which record shall be made before the article is delivered, and shall at all times be open to inspection by the officers of the district police and by the police authorities and officers of cities and towns; but no sale of cocaine or its salts shall be made except on the prescription of a physician. Whoever neglects to keep or refuses to show to said officers such record shall be punished by fine not exceeding fifty dollars. Whoever sells any of the poisonous articles named in this section without the written prescription of a physician, shall affix to the bottle, box or wrapper containing the article sold a label of red paper, upon which shall be printed in large black letters the word, Poison, and also the word, Antidote, and the name and place of business of the vendor. The name of an antidote, if there be any, for the poison sold, shall also be upon the label. Every neglect to affix such label to such poisonous article before the delivery thereof to the purchaser shall be punished by fine not exceeding fifty dollars. Whoever purchases poisons as aforesaid and gives a false or fictitious name to the vendor shall be punished by fine not exceeding fifty dollars. But nothing in this act shall be construed to apply to wholesale dealers and to manufacturing chemists in their sales to the retail trade, nor to the general merchant, who may sell in unbroken packages containing not less than one quarter of a pound, Paris green, London purple, or other arsenical poisons for the sole purpose of destroying potato bugs or other insect life upon plants, vines or trees: *provided*, that such merchant complies with the provisions of this section in respect to recording such sale and labelling each package sold.

General Provisions.

Section 21. It shall be the duty of the board of registration in pharmacy to investigate all complaints of disregard, non-compliance with, or violation of, the provisions of this act, and to bring all such cases to the notice of the proper prosecuting officers, and especially to prosecute all persons violating section seventeen of this act.

Section 22. In order properly to carry out the provisions of this act the board of registration in pharmacy may expend annually a sum not exceeding two thousand dollars, and an itemized statement of all expenses incurred shall be filed with the auditor of the Commonwealth, who, after they have been properly approved, shall allow them in the same manner as other claims against the Commonwealth.

Section 23. This act shall not apply to physicians putting up their own prescriptions or dispensing medicines to their patients; nor to the sale of drugs, medicines, chemicals or poisons at wholesale only; nor to the manufacture or sale of patent and proprietary medicines; nor to the sale of non-poisonous domestic remedies usually sold by grocers and others; nor shall any member of a copartnership, other than a registered pharmacist, be liable to the penalties hereof: *provided*, that such non-registered member shall not retail, compound for sale or dispense for medicinal purposes, drugs, medicines, chemicals or poisons, except under the personal supervision of a registered pharmacist.

Section 24. Sections five and six of chapter two hundred and eight of the Public Statutes, chapter three hundred and thirteen of the acts of the year eighteen hundred and eighty-five, chapters two hundred and sixty-seven and four hundred and thirty-one of the acts of the year eighteen hundred and eighty-seven, chapter two hundred and nine of the acts of the year eighteen hundred and eighty-eight, chapters two hundred and twenty-seven and four hundred and seventy-two of the acts of the year eighteen hundred and ninety-three, and chapter four hundred and thirty-five of the acts of the year eighteen hundred and ninety-four, are hereby repealed. [*Approved May 15, 1896.*

[Amended by chapter 522, Acts of 1901, by adding the following new sections: *Section 25.* In case a charge or complaint against a registered pharmacist of the Commonwealth is pending before the board of registration in pharmacy, such pharmacist or his counsel shall have the same right of access to all documents in the possession of said board as a person charged with an offence or crime before the courts of the Commonwealth would have. *Section 26.* Whoever violates any provision of this act, not otherwise specifically provided for, shall for each offence be punished by a fine of not less than fifty dollars. *Section 27.* When a person is convicted of the violation of any provision of this act the court in which or the magistrate before whom such conviction is had shall send to the board of registration in pharmacy a certificate under seal showing the time and place of such conviction.]

[CHAPTER 50, ACTS OF 1901.]

AN ACT MAKING APPROPRIATIONS FOR THE EXPENSE OF ENFORCING THE LAW TO REGULATE THE PRACTICE OF PHARMACY.

Be it enacted, etc., as follows:

SECTION 1. The sums hereinafter mentioned are appropriated, to be paid out of the treasury of the Commonwealth from the ordinary revenue, for the purposes specified, for the year ending on the thirty-first day of December, nineteen hundred and one, to wit: —

For expenses in connection with carrying out the law relative to complaints against registered pharmacists, a sum not exceeding two thousand dollars.

For services and expenses of the board of registration in pharmacy, salary and expenses of an agent, stenographer, postage, printing and incidental expenses, a sum not exceeding forty-five hundred dollars.

SECTION 2. This act shall take effect upon its passage. [*Approved February 14, 1901.*

[CHAPTER 87, ACTS OF 1901.]

AN ACT RELATIVE TO THE SALE OF INTOXICATING LIQUORS BY PHARMACISTS.

Be it enacted, etc., as follows:

SECTION 1. The fourth clause of section nine of chapter one hundred of the Public Statutes, as amended by chapter one hundred and fifty-eight of the acts of the year eighteen hundred and eighty-four, is hereby further amended by adding at the end thereof the words: — *provided, however,* that the phrase "or to a person known to have been supported in whole or in part by public charity at any time during the twelve months next preceding the date of the license," shall not apply in cases where the sale of liquor is made upon the prescription of a duly registered physician, — so as to read as follows: — Fourth, That no sale or delivery of liquor shall be made on the premises described in the license to a person known to be a drunkard, to an intoxicated person, or to a person who is known to have been intoxicated within the six months next preceding, or to a minor, either for his own use, the use of his parent, or of any other person, or to a person known to have been supported in whole or in part by public charity at any time during the twelve months next preceding the date of the license: *provided, however*, that the phrase "or to a person known to have been supported in whole or in part by public charity at any time during the twelve months next preceding the date of the license", shall not apply in cases where the sale of liquor is made upon the prescription of a duly registered physician.

SECTION 2. All acts and parts of acts inconsistent herewith are hereby repealed.

SECTION 3. This act shall take effect upon its passage. [*Approved February 27, 1901.*

PUBLIC DOCUMENT . . . . No. 53.

EIGHTEENTH ANNUAL REPORT

OF THE

CIVIL SERVICE COMMISSIONERS

OF

MASSACHUSETTS.

DECEMBER 27, 1901.

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Commonwealth of Massachusetts.

To the Honorable the Senate and House of Representatives in General Court assembled.

The Civil Service Commissioners of the Commonwealth, pursuant to section 2 of chapter 320 of the Acts of the Legislature for 1884, have the honor to submit this as their eighteenth annual report. The report relates to and covers their work from Oct. 1, 1900, to Oct. 1, 1901.

Upon Jan. 6, 1901, Commissioner Edward P. Wilbur died, and upon January 23 Winthrop L. Marvin of Boston was appointed to fill the vacancy created by the death. Mr. Marvin duly qualified as commissioner and assumed the duties. Upon the expiration of his term of office, in July last, he was reappointed and duly qualified.

During the year covered by this report the number of examinations in the classified public service has been as follows: —

General competitive examinations, ...	149
Special competitive examinations, ...	3
Non-competitive examinations, ...	66
	218

The commissioners, in adhering to their policy and belief that non-competitive examinations should be limited to cases required by law or necessity, have reduced the number from 82 to 66. Of these 66, 45 were for promotion, under the rules, and 19 were examinations of applicants for positions as plumbing or gas inspectors, under requirement of statute. There were only 2 non-competitive examinations for original appointment, 1 for clerical, historical and genealogical labor, and 1 where knowledge of statistics, German, French and proof-reading was required.

Twenty-four more competitive examinations were held than in the previous year.

During the year 2,853 citizens were examined, of which number 2,288 were men, including 47 veterans of the war of the rebellion, and 565 were women.

Of the persons examined, 1,904 passed the examination. Of the applicants examined, 2,762 had a school education and 91 had attended college.

Of those upon the eligible list, 567 men and 100 women were duly certified and appointed to positions in the public service. Of these, 10 were examined veterans, and received the preference required by statute. In addition, 41 unexamined veterans were appointed under the veteran exemption provided by law.

The average age of the persons examined was about thirty-eight years.

The reports of the secretary and chief examiner are published in the Appendix.

THE LABOR SERVICE.

The labor-rules apply to the cities of Boston, Worcester, Cambridge, New Bedford, Newton and Everett. Under chapter 449 of the Acts of 1896, the labor rules can be extended to cities with less than 100,000 population only by acceptance of the city council, with the approval of the mayor. With such acceptance and approval the commissioners can and will, at very small expense to any city, give to it the proved benefit of labor classification.

In Boston 3,400 men were registered during the year, of whom 227 were veterans. There were 204 requisitions for labor service received, and 1,861 men were certified for employment. Of those certified, 394, including 21 veterans, were employed.

In Worcester 1,515 were registered, including 17 veterans. There were 71 requisitions, upon which 1,639 men were certified, of whom 12 were veterans. Of these, 1,483, including 10 veterans, were employed.

In Cambridge 676 men, including 17 veterans, were registered. There were 32 requisitions received, and 631 men, including 12 veterans, were certified. Of these, 241, including 12 veterans, were employed.

In New Bedford 264 men were registered, including 8 veterans. There were 65 requisitions made, upon which 328 men were certified, and 132, including the 8 veterans, were employed.

In Newton the number registered was 112. There were 9 requisitions received, upon which 91 men were certified and 29 employed.

In Everett 290 men were registered, 42 requisitions were made and 419 men were certified, of whom 202, including 9 veterans, were employed.

The reports of the registrar of labor and registration clerks are published in the Appendix.

Extension of the Service.

Chapter 69 of the Acts of 1900 applied the civil service rules to the police and fire forces of Milton, and the rules have been successfully enforced in that town.

Early in the session of the Legislature of 1901 other towns applied for similar special legislation. The Legislature thereupon wisely determined to make the application of the system and rules to towns a matter of general law, and therefore provided, by chapter 78 of the Acts of 1901, that the rules shall apply to the police and fire forces of any town upon acceptance of the act by the voters of such town. This act has been duly accepted by the town of Revere, and the police and fire forces of that town have now passed under the control and protection of the civil service rules.

At a meeting of the school committee of Lowell, held April 29, 1901, it was voted to request the civil service commissioners to include the engineers and janitors of school buildings in said city within the civil service classification, schedule B, class 11, and this has been done.

In October, 1901, by vote of the mayor and aldermen of the city of Quincy, the permanent fire force of that city was included within the civil service classification.

The Rules.

The present civil service rules are the revision prepared with the approval of the Governor and Council in 1889. Since then there have been from time to time amendments, extending the classification of the public service and making other changes, deemed expedient in the administration of the system. The Legislature has almost annually amended the original civil service act of 1884, especially in relation to the preference to veterans, to the extension of the classified service, and even to regulation regarding physical qualifications to be required in certain branches of the service, and to the right of transfer and promotion.

For these reasons, and in view of the recent revision of the Public Statutes, embodying in chapter 19 of the Revised Laws the civil service act of 1884 and the amendments thereof, the commissioners have prepared a revision of all the civil service rules thereunder, and the same were on December 24 approved by the Governor and Council. The changes in the revision are mainly for the purpose of consolidation, conformity, and to prevent misunderstanding as to the proper meaning and effect. The revised rules so adopted and approved are herewith reported to the Legislature, and published in the Appendix. They go into effect on the first day of March, 1902.

Upon the death of Commissioner Wilbur, the commissioners ordered placed upon their records an appreciation of his public service. Honored for years with deserved public and private confidence, experienced in public affairs, always attentive to any duty assumed, clear-headed, impartial but firm in his convictions, he rendered to the Commonwealth and to this commission, for nearly twelve years, able, efficient and conscientious service. His death is to the public a loss and to his associate commissioners a personal sorrow.

Respectfully submitted,

CHAS. THEO. RUSSELL,
CHAS. H. PORTER,
WINTHROP L. MARVIN,
Civil Service Commissioners.

DEC. 27, 1901.

APPENDIX.

APPENDIX.

EXAMINATIONS AND APPOINTMENTS.

From Oct. 1, 1900, to Sept. 30, 1901, inclusive, there were held for the State and Boston services 76 examinations, as follows: —

Competitive Examinations.

For State clerical service,	6	
For Boston clerical service,	4	
For State stenographer-typewriter service,	3	
For Boston stenographer-typewriter service,	2	
For State messenger service,	2	
For Boston messenger service,	2	
For State prison service,	1	
For Boston prison service,	1	
For metropolitan park police service,	1	
For Boston fire service,	2	
For Boston police service,	4	
For Boston drawtender service,	1	
For Boston foreman and sub-foreman service,	4	
For State inspection service,	2	
For Boston inspection service,	3	
For Boston school janitor service,	1	
For Boston truant officer service,	1	
For Boston civil engineering service,	3	
	—	43

Non-competitive Examinations.

For Boston clerical service,	2	
For State clerical promotion,	3	
For metropolitan park police promotion,	2	
For Boston fire promotion,	9	
For Boston police promotion,	10	
For Boston inspection promotion,	1	
For Boston plumbing and gas fitting inspection service,	2	
For Boston civil engineering promotion,	4	
	—	33

There have been held 142 examinations for original appointments and promotions in the clerical, stenographer-typewriter, police, drawtender, foreman, inspection, fire, janitor, civil engineering and superintendent services of cities other than Boston, and for plumbing inspection service in cities and towns, under chapter 455, Acts of 1894, as follows: —

	Number of Examinations.	Number Examined.	
Attleborough: —			
Plumbing inspection service,	1	1	
			1
Beverly: —			
Civil engineering service,	1	1	
			1
Brockton: —			
Clerical service,	1	10	
Police service,	1	6	
Foreman service,	1	1	
Civil engineering service,	1	1	
			18
Brookline: —			
Police service,	1	28	
Inspection service,	1	15	
Fire service,	1	33	
Fire promotion,	1	1	
Civil engineering service,	1	1	
			78
Cambridge: —			
Clerical service,	1	13	
Police service,	1	19	
Drawtender service,	1	5	
Foreman and inspection service,	2	11	
Fire service,	1	17	
Fire promotion,	1	1	
School janitor service,	2	8	
Civil engineering service,	1	2	
			76
Chelsea: —			
Clerical service,	1	3	
Stenographer-typewriter service,	2	2	
Police service,	1	14	
Civil engineering service,	1	1	
			20
Chicopee: —			
Clerical service,	2	10	
Police service,	1	5	
			15

	Number of Examinations.	Number Examined.	
Everett:—			
Clerical service,	1	5	
Police service,	1	12	
			17
Fall River:—			
Clerical service,	1	28	
Police service,	1	39	
Foreman service,	1	1	
			68
Fitchburg:—			
Clerical service,	2	31	
Police service,	1	14	
Police promotion,	3	3	
Civil engineering service,	1	2	
			50
Gloucester:—			
Clerical service,	1	3	
Police service,	1	7	
			10
Haverhill:—			
Clerical service,	1	10	
Police service,	1	13	
Police promotion,	1	1	
Civil engineering service,	1	1	
			25
Holyoke:—			
Clerical service,	2	31	
Clerical promotion,	1	1	
Police service,	1	25	
Plumbing inspection service,	11	11	
Foreman service,	1	4	
Civil engineering service,	1	14	
			86
Lawrence:—			
Clerical service,	1	2	
Police service,	1	39	
Foreman service,	1	1	
			42
Lowell:—			
Clerical service,	1	25	
Police service,	1	39	
Foreman and inspection service,	2	4	
			68

	Number of Examinations.	Number Examined.	
Lynn:—			
Clerical service,	1	7	
Police service,	1	11	
Inspection service,	1	2	
Civil engineering service,	2	2	
			22
Malden:—			
Clerical service,	1	4	
Police service,	1	19	
Inspection service,	1	5	
Civil engineering service,	1	1	
			29
Medford:—			
Clerical service,	1	7	
Police service,	1	9	
Civil engineering service,	1	1	
			17
Melrose:—			
Clerical service,	1	4	
Police service,	1	5	
			9
Milton:—			
Fire service,	1	9	
			9
New Bedford:—			
Clerical service,	1	5	
Police service,	1	16	
Foreman and inspection service,	2	8	
Fire service,	1	14	
			43
Newburyport:—			
Police service,	1	7	
			7
Newton:—			
Clerical service,	1	10	
Stenographer-typewriter service,	1	3	
Police service,	1	13	
Civil engineering service,	1	3	
Civil engineering promotion,	1	1	
			30
North Adams:—			
Police service,	1	20	
Foreman and inspection service,	1	1	
Civil engineering service,	1	3	
			24

	Number of Examinations.	Number Examined.	
Northampton : —			
Clerical service,	1	2	
Police service,	1	3	
			5
Quincy : —			
Clerical service,	1	8	
Police service,	1	15	
Foreman and inspection service,	1	3	
Fire service,	1	10	
Civil engineering service,	1	3	
			39
Salem : —			
Police service,	2	23	
Superintendent service,	1	2	
			25
Somerville : —			
Clerical service,	1	28	
Police service,	1	38	
Foreman service,	1	6	
			72
Springfield : —			
Police promotion,	5	5	
Foreman and inspection service,	2	26	
Civil engineering service,	1	2	
			33
Taunton : —			
Clerical service,	1	2	
Police service,	1	15	
Civil engineering service,	2	2	
			19
Waltham : —			
Clerical service,	2	17	
Civil engineering service,	2	3	
			20
Webster : —			
Plumbing inspection service,	4	4	
			4
Winthrop : —			
Plumbing inspection service,	1	1	
			1

Worcester: —	Number of Examinations.	Number Examined.	
Clerical service,	1	57	
Police service,	1	44	
Police promotion,	1	1	
Foreman and inspection service,	1	24	
Civil engineering service,	2	4	
Civil engineering promotion,	2	2	
			132
			1,115

The whole number of persons examined for original appointments and promotions in the first division is as follows: —

For clerical service,	864	
For clerical promotion,	4	
For plumbing inspection service in cities and towns,	19	
For stenographer-typewriter service,	98	
For messenger service,	25	
For prison service,	64	
For metropolitan park police service,	42	
For metropolitan park police promotion,	2	
For fire service,	273	
For fire promotion,	11	
For police service,	913	
For police promotion,	20	
For drawtender service,	24	
For foreman and inspection service,	287	
For inspection promotion,	1	
For school janitor service,	50	
For truant officer service,	32	
For civil engineering service,	115	
For civil engineering promotion,	7	
For superintendent service,	2	
		2,853

The whole number passed is as follows: —

For clerical service, 555, or 64.24 per cent. of those examined.

For clerical promotion, 2, or 50 per cent. of those examined.

For plumbing inspection service in cities and towns, 8, or 42.11 per cent. of those examined.

For stenographer-typewriter service, 68, or 69.39 per cent. of those examined.

For messenger service, 10, or 40 per cent. of those examined.

For prison service, 51, or 79.70 per cent. of those examined.

For metropolitan park police service, 23, or 54.77 per cent. of those examined.

For metropolitan park police promotion, 2, or 100 per cent. of those examined.

For fire service, 166, or 60.81 per cent. of those examined.
For fire promotion, 11, or 100 per cent. of those examined.
For police service, 623, or 68.24 per cent. of those examined.
For police promotion, 20, or 100 per cent. of those examined.
For drawtender service, 20, or 83.34 per cent. of those examined.
For foreman and inspection service, 201, or 70.04 per cent. of those examined.
For inspection promotion, 1, or 100 per cent. of those examined.
For school janitor service, 26, or 52 per cent. of those examined.
For truant officer service, 28, or 87.50 per cent. of those examined.
For civil engineering service, 82, or 71.31 per cent. of those examined.
For civil engineering promotion, 6, or 85.72 per cent. of those examined.
For superintendent service, 1, or 50 per cent. of those examined.

The whole number appointed from those examined is as follows: —

In the clerical service,	125	
By promotion in the clerical service,	5	
In the plumbing inspection service in cities and towns,	6	
In the stenographer-typewriter service,	24	
In the messenger service,	4	
In the prison service,	7	
In the metropolitan park police service,	7	
By promotion in the metropolitan park police service,	2	
In the fire service,	53	
By promotion in the fire service,	19	
In the police service,	231	
By promotion in the police service,	27	
In the drawtender service,	15	
In the foreman and inspection service,	73	
By promotion in the inspection service,	1	
In the school janitor service,	14	
In the truant officer service,	2	
In the civil engineering service,	42	
By promotion in the civil engineering service,	10	
		667

The average age of all the persons examined is about thirty-eight years.

Of the 1,904 persons who passed the examinations, 70 were college educated.

The whole number of veterans who passed examinations for original appointment is 21; the whole number of original appointments of examined veterans is 7.

The whole number of unexamined veterans appointed is 41.

Following are the figures on which this statement is based: —

COMMONWEALTH SERVICE.

	NUMBER OF EXAMINATIONS.			NUMBER EXAMINED.			NUMBER PASSED.			NUMBER APPOINTED FROM THOSE EXAMINED.			Number of Unexamined Veterans appointed.	AVERAGE AGE OF THOSE PASSED.			AVERAGE AGE OF THOSE FAILED.			EDUCATION OF THOSE PASSED.		EDUCATION OF THOSE FAILED.	
	General Competitive.	Special Competitive.	Non-competitive.	Male Civilians.	Veterans.	Females.	Male Civilians.	Veterans.	Females.	Male Civilians.	Veterans.	Females.		Male Civilians.	Veterans.	Females.	Male Civilians.	Veterans.	Females.	Common School.	College.	Common School.	College.
State clerical service, ...	6	-	-	187	15	245	58	4	184	1	1	15	1	27.03	58.50	25.06	28.18	58.20	26.57	227	19	143	8
State clerical promotion, ...	-	-	3	2	-	1	1	-	1	3	-	2	-	23.00	-	24.00	22.00	-	-	2	-	1	-
State stenographer-typewriter service.	3	-	-	4	-	38	4	-	28	2	-	17	-	25.00	-	23.57	-	-	21.60	32	-	10	-
State messenger service, ...	2	-	-	6	1	-	3	-	-	4	-	-	1	18.00	-	-	29.00	57.00	-	3	-	4	-
State prison service, ...	1	-	-	47	1	-	40	-	-	5	-	-	-	32.50	-	-	34.00	56.00	-	40	-	8	-
Metropolitan park police service, .	1	-	-	42	-	-	23	-	-	7	-	-	-	31.04	-	-	32.89	-	-	23	-	19	-
Metropolitan park police promotion	-	-	2	2	-	-	2	-	-	2	-	-	-	39.00	-	-	-	-	-	2	-	-	-
District police service, ...	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
State foreman and inspection service.	2	-	-	16	2	-	14	2	-	11	2	-	2	38.00	59.50	-	34.50	-	-	16	-	2	-
Aids to State Fire Marshal, . . .	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
	15	-	5	256	19	284	145	6	213	35	3	34	7	29 20	59.00	24.21	30.10	57.07	24.09	345	19	187	8
	20			559			364			72			7	37.47			37.09			364		195	

BOSTON SERVICE.

Boston clerical service,	4	-	2	93	1	51	45	-	30	30	-	9	2	26.02	-	24.40	28.06	61.00	25.00	73	2	68	2
Boston stenographer-typewriter service.	2	-	-	10	-	41	8	-	25	1	-	2	-	25.13	-	24.44	23.50	-	23.19	33	-	18	-
Boston messenger service,	2	-	-	17	1	-	7	-	-	-	-	-	2	23.28	-	-	22.20	59.00	-	6	1	10	1
Boston prison service,	1	-	-	15	1	-	11	-	-	1	-	-	2	33.27	-	-	41.75	56.00	-	11	-	5	-
Boston fire service,	2	-	-	190	-	-	102	-	-	34	-	-	-	25.29	-	-	24.80	-	-	102	-	88	-
Boston fire promotion,	-	-	9	9	-	-	9	-	-	16	1	-	-	33.56	-	-	-	-	-	9	-	-	-
Boston police service,	4	-	-	415	-	-	265	-	-	105	-	-	1	27.89	-	-	28.83	-	-	265	-	150	-
Boston police promotion,	-	-	10	10	-	-	10	-	-	14	2	-	-	41.10	-	-	-	-	-	10	-	-	-
Boston drawtender service,	1	-	-	19	-	-	15	-	-	14	-	-	-	33.53	-	-	43.00	-	-	15	-	4	-
Boston foreman and sub-foreman service.	4	-	-	47	3	-	37	1	-	-	1	-	-	35.08	55.00	-	36.40	55.50	-	38	-	12	-
Boston inspection service,	3	-	-	108	4	-	59	3	-	25	-	-	2	34.78	59.00	-	35.66	54.00	-	60	2	45	-
Boston inspection promotion,	-	-	1	1	-	-	1	-	-	1	-	-	-	33.00	-	-	-	-	-	1	-	-	-
Boston plumbing and gas fitting inspection service.	-	-	2	2	-	-	2	-	-	2	-	-	-	34.50	-	-	-	-	-	2	-	-	-
Boston school janitor service,	1	-	-	40	1	1	21	1	1	12	1	-	2	37.90	54.00	35.00	42.32	-	-	23	-	19	-
Boston truant officer service,	1	-	-	32	-	-	28	-	-	2	-	-	1	35.89	-	-	38.00	-	-	28	-	4	-
Boston civil engineering service,	3	-	-	68	-	-	47	-	-	24	-	-	-	24.43	-	-	23.48	-	-	28	19	20	1
Boston civil engineering promotion,	-	-	4	4	-	-	4	-	-	8	-	-	-	27.25	-	-	-	-	-	4	-	-	-
	28	-	28	1,075	11	93	671	5	56	289	5	11	12	31.29	56.00	27.95	32.38	57.10	24.10	708	24	443	4
	56			1,179			732			305			12	33.41			37.84			732		447	

CLERICAL, STENOGRAPHER-TYPEWRITER, PRISON, DRAWTENDER, FOREMAN, INSPECTION, FIRE, JANITOR, CIVIL ENGINEERING AND SUPERINTENDENT SERVICES, CITIES OTHER THAN BOSTON, AND TOWNS, UNDER CHAPTER 455, ACTS OF 1894.

	NUMBER OF EXAMINATIONS.			NUMBER EXAMINED.			NUMBER PASSED.			NUMBER APPOINTED FROM THOSE EXAMINED.			Number of Unexamined Veterans appointed.	AVERAGE AGE OF THOSE PASSED.			AVERAGE AGE OF THOSE FAILED.			EDUCATION OF THOSE PASSED.		EDUCATION OF THOSE FAILED.	
	General Competitive.	Special Competitive.	Non-competitive	Male Civilians.	Veterans.	Females.	Male Civilians.	Veterans.	Females.	Male Civilians.	Veterans.	Females.		Male Civilians.	Veterans.	Females.	Male Civilians.	Veterans.	Females.	Common School.	College.	Common School.	College.
Attleborough, plumbing inspection,	-	-	1	1	-	-	-	-	-	1	-	-	-	-	-	-	41.00	-	-	-	-	1	-
Beverly, civil engineering, . .	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	20.00	-	-	-	-	1	-
Brockton, clerical, ...	1	-	-	3	-	7	3	-	6	-	-	3	-	21.00	-	23.00	-	-	19.00	9	-	1	-
Brockton, foreman, ...	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	33.00	-	-	-	-	1	-
Brockton, civil engineering, . .	1	-	-	1	-	-	1	-	-	1	-	-	-	18.00	-	-	-	-	-	1	-	-	-
Brookline, clerical, ...	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Brookline, inspection, . . .	1	-	-	15	-	-	14	-	-	1	-	-	-	28.64	-	-	37.00	-	-	14	-	1	-
Brookline, fire, ...	1	-	-	33	-	-	25	-	-	4	-	-	-	26.48	-	-	30.13	-	-	25	-	8	-
Brookline, fire promotion, . .	-	-	1	1	-	-	1	-	-	1	-	-	-	34.00	-	-	-	-	-	1	-	-	-
Brookline, civil engineering, . .	1	-	-	1	-	-	1	-	-	2	-	-	-	21.00	-	-	-	-	-	1	-	-	-
Cambridge, clerical, ...	1	-	-	-	-	13	11	-	-	-	-	4	-	-	-	21.36	-	-	24.50	10	1	2	-
Cambridge, drawtender, . . .	1	-	-	6	-	-	5	-	-	1	-	-	-	36.60	-	-	-	-	-	5	-	-	-

Cambridge, foreman and inspection,	2	-	-	7	4	-	6	3	-	-	1	-	-	40.17	58.67	-	49.00	62.00	-	8	1	2	-
Cambridge, fire, ...	1	-	-	17	-	-	10	-	-	3	-	-	-	23.50	-	-	28.14	-	-	10	-	7	-
Cambridge, fire promotion, . .	-	-	1	1	-	-	1	-	-	1	-	-	-	30.00	-	-	-	-	-	1	-	-	-
Cambridge, school janitor, . .	1	1	-	7	1	-	2	1	-	-	-	-	-	45.00	-	-	46.40	59.00	-	3	-	5	-
Cambridge, civil engineering, . .	1	-	-	2	-	-	1	-	-	1	-	-	-	19.00	-	-	18.00	-	-	1	-	1	-
Chelsea, clerical, ...	1	-	-	3	-	-	1	-	-	-	-	-	-	23.00	-	-	25.50	-	-	1	-	2	-
Chelsea, stenographer-typewriter, .	2	-	-	-	-	2	-	-	2	-	-	1	-	29.00	-	-	-	-	-	2	-	-	-
Chelsea, civil engineering, . .	1	-	-	1	-	-	1	-	-	-	-	-	-	22.00	-	-	-	-	-	1	-	-	-
Chicopee, clerical, ...	2	-	-	6	4	-	5	1	-	1	-	-	1	24.60	62.00	-	18.00	57.67	-	6	-	4	-
Everett, clerical, ...	1	-	-	2	-	3	2	-	3	-	-	-	-	26.50	-	23.67	-	-	-	5	-	-	-
Fall River, clerical, ...	1	-	-	11	-	17	5	-	13	-	-	3	-	26.30	-	22.46	21.83	-	20.50	18	-	10	-
Fall River, foreman, ...	1	-	-	1	-	-	1	-	-	-	-	-	-	43.00	-	-	-	-	-	1	-	-	-
Fitchburg, clerical, ...	2	-	-	17	-	14	14	-	14	1	-	1	-	30.57	-	22.36	42.33	-	-	26	2	3	-
Fitchburg, stenographer-typewriter,	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Fitchburg, foreman, ...	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Fitchburg, civil engineering, . .	1	-	-	2	-	-	2	-	-	2	-	-	-	20.00	-	-	-	-	-	2	-	-	-
Gloucester, clerical, ...	1	-	-	1	-	2	1	-	2	1	-	-	-	28.00	-	29.00	-	-	-	3	-	-	-
Haverhill, clerical, ...	1	-	-	1	1	8	1	1	8	-	-	4	-	25.00	56.00	21.00	-	-	-	9	1	-	-
Haverhill, civil engineering, . .	1	-	-	1	-	-	1	-	-	1	-	-	-	20.00	-	-	-	-	-	1	-	-	-
Holyoke, clerical, ...	1	1	-	15	2	14	7	-	9	1	-	2	-	29.00	-	24.13	33.63	56.50	24.60	16	-	15	-
Holyoke, clerical promotion, . .	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	35.00	-	-	1	-
Holyoke, plumbing inspection, .	-	-	11	11	-	-	4	-	-	1	-	-	-	39.50	-	-	40.29	-	-	4	-	7	-

CLERICAL, STENOGRAPHER-TYPEWRITER, PRISON, DRAWTENDER, FOREMAN, ETC. — *Continued.*

	NUMBER OF EXAMINATIONS.			NUMBER EXAMINED.			NUMBER PASSED.			NUMBER APPOINTED FROM THOSE EXAMINED.			Number of Unexamined Veterans appointed.	AVERAGE AGE OF THOSE PASSED.			AVERAGE AGE OF THOSE FAILED.			EDUCATION OF THOSE PASSED.		EDUCATION OF THOSE FAILED.	
	General Competitive.	Special Competitive.	Non-competitive.	Male Civilians.	Veterans.	Females.	Male Civilians.	Veterans.	Females.	Male Civilians.	Veterans.	Females.		Male Civilians.	Veterans.	Females.	Male Civilians.	Veterans.	Females.	Common School.	College.	Common School.	College.
Holyoke, foreman,	1	-	-	3	1	-	2	1	-	1	-	-	-	48.00	56.00	-	40.00	-	-	3	-	1	-
Holyoke, janitor,	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Holyoke, civil engineering,	1	-	-	14	-	-	11	-	-	-	-	-	-	32.82	-	-	35.67	-	-	11	-	3	-
Lawrence, clerical,	1	-	-	1	-	1	-	-	1	-	-	-	1	-	-	18.00	23.00	-	-	1	-	1	-
Lawrence, foreman,	1	-	-	1	-	-	1	-	-	-	-	-	1	26.00	-	-	-	-	-	1	-	-	-
Lawrence, superintendent,	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Lowell, clerical,	1	-	-	14	-	11	6	-	8	2	-	-	1	26.70	-	23.00	22.63	-	18.33	14	-	9	2
Lowell, foreman and inspection,	2	-	-	4	-	-	3	-	-	1	-	-	1	38.00	-	-	33.00	-	-	3	-	1	-
Lynn, clerical,	1	-	-	3	-	4	2	-	2	-	-	2	1	24.50	-	31.50	29.00	-	34.00	4	-	2	1
Lynn, inspection,	1	-	-	2	-	-	2	-	-	1	1	-	1	53.50	-	-	-	-	-	2	-	-	-
Lynn, civil engineering,	2	-	-	2	-	-	1	-	-	-	-	-	-	25.00	-	-	24.00	-	-	-	1	1	-
Malden, clerical,	1	-	-	2	-	2	2	-	1	-	-	-	-	25.00	-	21.00	-	-	40.00	3	-	1	-
Malden, inspection,	1	-	-	5	-	-	5	-	-	2	-	-	-	30.20	-	-	-	-	-	5	-	-	-

Malden, civil engineering,	1	-	-	1	-	-	1	-	-	-	-	-	-	24.00	-	-	-	-	-	1	-	-	-
Medford, clerical,	1	-	-	2	-	5	2	-	4	-	-	1	-	32.00	-	24.75	-	-	20.00	5	1	1	-
Medford, civil engineering,	1	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	22.00	-	-	1	-	-	-
Melrose, clerical,	1	-	-	1	-	3	1	-	3	-	-	1	-	26.00	-	24.67	-	-	-	4	-	-	-
Milton, fire,	1	-	-	9	-	-	7	-	-	6	-	-	-	24.71	-	-	24.71	-	-	7	-	2	-
New Bedford, clerical,	1	-	-	4	-	1	4	-	1	2	-	-	-	42.00	-	21.00	-	-	-	5	-	-	-
New Bedford, foreman and inspection.	2	-	-	8	-	-	5	-	-	1	-	-	-	28.20	-	-	39.00	-	-	5	-	3	-
New Bedford, fire,	1	-	-	14	-	-	13	-	-	2	-	-	-	28.23	-	-	31.00	-	-	13	-	1	-
Newton, clerical,	1	-	-	2	-	8	1	-	8	1	-	8	-	31.00	-	25.63	18.00	-	-	8	1	1	-
Newton, stenographer-typewriter,	1	-	-	-	-	3	-	-	1	-	-	-	-	-	-	18.00	-	-	21.50	1	-	2	-
Newton, civil engineering,	1	-	-	8	-	-	2	-	-	7	-	-	-	25.00	-	-	21.00	-	-	-	2	1	-
Newton, civil engineering promotion.	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	34.00	-	-	-	-	1	-
North Adams, foreman and inspection.	1	-	-	1	-	-	1	-	-	8	-	-	1	65.00	-	-	-	-	-	1	-	-	-
North Adams, civil engineering,	1	-	-	3	-	-	2	-	-	1	-	-	-	24.00	-	-	27.00	-	-	2	-	1	-
Northampton, clerical,	1	-	-	-	-	2	-	-	2	-	-	-	-	37.00	-	-	-	-	-	2	-	-	-
Quincy, clerical,	1	-	-	2	-	6	2	-	6	-	-	2	-	32.50	-	25.00	-	-	-	8	-	-	-
Quincy, foreman and inspection,	1	-	-	3	-	-	3	-	-	-	-	-	-	48.30	-	-	-	-	-	3	-	-	-
Quincy, fire,	1	-	-	10	-	-	9	-	-	-	-	-	-	29.78	-	-	35.00	-	-	9	-	1	-
Quincy, civil engineering,	1	-	-	3	-	-	1	-	-	-	-	-	-	23.00	-	-	21.00	-	-	-	1	-	2
Salem, clerical,	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
Salem, superintendent,	-	1	-	1	1	-	1	-	-	-	-	-	-	39.00	-	-	-	57.00	-	1	-	1	-
Somerville, clerical,	1	-	-	18	-	10	7	-	8	2	-	7	-	24.29	-	21.00	31.45	-	20.00	18	2	18	-

CLERICAL, STENOGRAPHER-TYPEWRITER, PRISON, DRAWTENDER, FOREMAN, ETC. — *Concluded.*

	NUMBER OF EXAMINATIONS.			NUMBER EXAMINED.			NUMBER PASSED.			NUMBER APPOINTED FROM THOSE EXAMINED.			Number of Unexamined Veterans appointed.	AVERAGE AGE OF THOSE PASSED.			AVERAGE AGE OF THOSE FAILED.			EDUCATION OF THOSE PASSED.		EDUCATION OF THOSE FAILED.	
	General Competitive.	Special Competitive.	Non-competitive.	Male Civilians.	Veterans.	Females.	Male Civilians.	Veterans.	Females.	Male Civilians.	Veterans.	Females.		Male Civilians.	Veterans.	Females.	Male Civilians.	Veterans.	Females.	Common School.	College.	Common School.	College.
Somerville, foreman,	1	-	-	6	-	-	5	-	-	-	-	-	-	35.40	-	-	28.00	-	-	4	1	1	-
Somerville, fire,	-	-	-	-	-	-	-	-	-	4	-	-	1	-	-	-	-	-	-	-	-	-	-
Springfield, clerical,	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-
Springfield, foreman and inspection,	2	-	-	24	2	-	15	2	-	8	-	-	-	40.87	60.00	-	51.78	-	-	16	1	8	1
Springfield, prison,	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Springfield, civil engineering,	1	-	-	2	-	-	2	-	-	-	-	-	-	21.00	-	-	-	-	-	1	1	-	-
Taunton, clerical,	1	-	-	-	-	2	-	-	2	-	-	2	-	-	-	34.00	-	-	-	2	-	-	-
Taunton, civil engineering,	2	-	-	2	-	-	1	-	-	-	-	-	-	20.00	-	-	20.00	-	-	-	1	1	-
Waltham, clerical,	2	-	-	8	-	9	4	-	7	-	-	-	1	29.25	-	22.28	29.25	-	30.50	9	2	6	-
Waltham, civil engineering,	2	-	-	3	-	-	2	-	-	1	-	-	-	24.00	-	-	17.00	-	-	-	2	1	-
Webster, plumbing inspection,	-	-	4	4	-	-	1	-	-	1	-	-	-	31.00	-	-	29.00	-	-	1	-	-	3
Winthrop, plumbing inspection,	-	-	1	1	-	-	1	-	-	1	-	-	-	41.00	-	-	-	-	-	1	-	-	-
Worcester, clerical,	1	-	-	17	-	40	8	-	35	5	-	4	-	23.50	-	21.11	24.44	-	21.20	43	-	14	-

Worcester, foreman and inspection,	1	-	-	23	1	-	15	1	-	12	-	-	2	35.40	57.00	-	43.00	-	-	14	2	8	-
Worcester, civil engineering, . .	2	-	-	4	-	-	4	-	-	2	-	-	-	22.00	-	-	-	-	-	3	1	-	-
Worcester, civil engineering promotion.	-	-	2	2	-	-	2	-	-	2	-	-	-	35.40	-	-	-	-	-	1	1	-	-
	78	8	23	402	17	188	283	10	147	96	2	55	13	30.34	58.28	25.32	30.20	58.43	25.32	415	25	158	9
	104			607			440			153			13	87.98			87.98			440		167	

POLICE SERVICE, CITIES OTHER THAN BOSTON.

	NUMBER OF EXAMINATIONS.			NUMBER EXAMINED.			NUMBER PASSED.			NUMBER APPOINTED FROM THOSE EXAMINED.			Number of Unexamined Veterans appointed.	AVERAGE AGE OF THOSE PASSED.			AVERAGE AGE OF THOSE FAILED.			EDUCATION OF THOSE PASSED.		EDUCATION OF THOSE FAILED.	
	General Competitive.	Special Competitive.	Non-competitive.	Male Civilians.	Veterans.	Females.	Male Civilians.	Veterans.	Females.	Male Civilians.	Veterans.	Females.		Male Civilians.	Veterans.	Females.	Male Civilians.	Veterans.	Females.	Common School.	College.	Common School.	College.
Brockton,	1	-	-	6	-	-	1	-	-	6	-	-	-	25.00	-	-	30.80	-	-	1	-	5	-
Brookline,	1	-	-	28	-	-	22	-	-	4	-	-	-	28.23	-	-	28.00	-	-	21	1	6	-
Cambridge,	1	-	-	19	-	-	12	-	-	4	-	-	-	28.33	-	-	25.00	-	-	12	-	7	-
Chelsea,	1	-	-	14	-	-	10	-	-	2	-	-	-	29.40	-	-	31.00	-	-	10	-	4	-
Chicopee,	1	-	-	5	-	-	2	-	-	-	-	-	-	33.50	-	-	26.33	-	-	2	-	3	-
Everett,	1	-	-	12	-	-	7	-	-	-	-	-	-	28.14	-	-	31.80	-	-	7	-	5	-
Fall River,	1	-	-	39	-	-	27	-	-	9	-	-	-	28.81	-	-	28.67	-	-	27	-	12	-
Fitchburg,	1	-	-	14	-	-	10	-	-	5	-	-	-	30.00	-	-	34.25	-	-	10	-	4	-
Fitchburg, promotion,	-	-	3	3	-	-	3	-	-	3	-	-	-	41.00	-	-	-	-	-	3	-	-	-
Gloucester,	1	-	-	7	-	-	5	-	-	1	-	-	-	30.40	-	-	29.00	-	-	5	-	2	-
Haverhill,	1	-	-	13	-	-	12	-	-	7	-	-	4	29.44	-	-	22.00	-	-	12	-	1	-
Haverhill, promotion,	-	-	1	1	-	-	1	-	-	1	-	-	1	40.00	-	-	-	-	-	1	-	-	-
Holyoke,	1	-	-	25	-	-	17	-	-	2	-	-	-	29.71	-	-	26.25	-	-	17	-	8	-
Lawrence,	1	-	-	39	-	-	30	-	-	7	-	-	-	29.50	-	-	31.33	-	-	30	-	9	-
Lowell,	1	-	-	39	-	-	22	-	-	20	-	-	-	29.09	-	-	28.41	-	-	21	1	17	-

Lowell, promotion,	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Lynn,	1	-	-	11	-	-	7	-	-	1	-	-	1	28.57	-	-	31.25	-	-	7	-	4	-
Malden,	1	-	-	19	-	-	17	-	-	8	-	-	-	31.06	-	-	33.50	-	-	17	-	2	-
Medford,	1	-	-	9	-	-	8	-	-	-	-	-	-	30.87	-	-	26.00	-	-	8	-	1	-
Melrose,	1	-	-	5	-	-	4	-	-	1	-	-	-	30.50	-	-	31.00	-	-	4	-	1	-
Milton,	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
New Bedford,	1	-	-	16	-	-	10	-	-	15	-	-	-	31.10	-	-	29.83	-	-	10	-	6	-
Newburyport,	1	-	-	7	-	-	6	-	-	5	-	-	-	28.17	-	-	32.00	-	-	6	-	1	-
Newton,	1	-	-	13	-	-	13	-	-	1	-	-	-	29.31	-	-	-	-	-	18	-	-	-
North Adams,	1	-	-	20	-	-	11	-	-	2	-	-	-	27.45	-	-	30.78	-	-	11	-	9	-
Northampton,	1	-	-	8	-	-	8	-	-	2	-	-	1	29.33	-	-	-	-	-	8	-	-	-
Quincy,	1	-	-	15	-	-	14	-	-	-	-	-	-	34.00	-	-	23.00	-	-	14	-	1	-
Salem,	2	-	-	23	-	-	15	-	-	-	-	-	-	27.58	-	-	30.50	-	-	15	-	8	-
Somerville,	1	-	-	33	-	-	28	-	-	8	-	-	-	28.32	-	-	28.00	-	-	28	-	10	-
Springfield, promotion,	-	-	5	5	-	-	5	-	-	5	-	-	-	51.40	-	-	-	-	-	5	-	-	-
Taunton,	1	-	-	15	-	-	12	-	-	8	-	-	1	32.58	-	-	32.67	-	-	12	-	8	-
Taunton, promotion,	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Worcester,	1	-	-	44	-	-	33	-	-	7	-	-	-	27.12	-	-	28.63	-	-	33	-	11	-
Worcester, promotion,	-	-	1	1	-	-	1	-	-	1	-	-	-	41.00	-	-	-	-	-	1	-	-	-
	28	-	10	506	-	-	368	-	-	137	-	-	9	31.25	-	-	29.20	-	-	366	2	140	-
	38			506			368			137			9	31.25			29.20			368		140	

SUMMARY.

	NUMBER OF EXAMINATIONS.			NUMBER EXAMINED.			NUMBER PASSED.			NUMBER APPOINTED FROM THOSE EXAMINED.			Number of Unexamined Veterans appointed.	AVERAGE AGE OF THOSE PASSED.			AVERAGE AGE OF THOSE FAILED.			EDUCATION OF THOSE PASSED.		EDUCATION OF THOSE FAILED.	
	General Competitive.	Special Competitive.	Non-competitive.	Male Civilians.	Veterans.	Females.	Male Civilians.	Veterans.	Females.	Male Civilians.	Veterans.	Females.		Male Civilians.	Veterans.	Females.	Male Civilians.	Veterans.	Females.	Common School.	College.	Common School.	College.
State clerical service, ...	6	-	-	137	15	245	58	4	184	1	1	15	1	27.03	58.50	25.06	28.18	58.20	26 57	227	19	143	8
State clerical promotion, . . .	-	-	8	2	-	1	1	-	1	3	-	2	-	23.00	-	24.00	22.00	-	-	2	-	1	-
Boston clerical service, . . .	4	-	2	93	1	51	45	-	30	30	-	9	2	26.02	-	24.40	28.06	61.00	25.00	73	2	68	2
Other cities, clerical service, . .	27	1	-	133	7	182	89	2	143	16	-	53	5	28.01	59.00	24.04	26.59	57.09	24.78	224	10	85	3
Other cities, clerical promotion, .	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	35.00	-	-	1	-
State stenographer-typewriter service.	3	-	-	4	-	38	4	-	28	2	-	17	-	25.00	-	23.57	-	-	21.60	32	-	10	-
Boston stenographer-typewriter service.	2	-	-	10	-	41	8	-	25	1	-	2	-	25.13	-	24.44	23.50	-	23.19	33	-	18	-
Other cities, stenographer-typewriter service	3	-	-	-	-	5	-	-	3	-	-	2	-	29.00	-	18.00	-	-	21.50	8	-	2	-
State messenger service, . . .	2	-	-	6	1	-	3	-	-	4	-	-	1	18.00	-	-	29.00	57.00	-	3	-	4	-
Boston messenger service, . .	2	-	-	17	1	-	7	-	-	-	-	-	2	23.28	-	-	22.20	59.00	-	6	1	10	1
State prison service, ...	1	-	-	47	1	-	40	-	-	5	-	-	-	32.50	-	-	34.00	56.00	-	40	-	8	-
Boston prison service, . . .	1	-	-	15	1	-	11	-	-	1	-	-	2	33.27	-	-	41.75	56.00	-	11	-	5	-
Other cities, prison service, . .	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Metropolitan park police service, .	1	-	-	42	-	-	23	-	-	7	-	-	-	31.04	-	-	32.89	-	-	23	-	19	-
Metropolitan park police promotion.	-	-	2	2	-	-	2	-	-	2	-	-	-	39.00	-	-	-	-	-	2	-	-	-
Boston fire service, ...	2	-	-	190	-	-	102	-	-	34	-	-	-	25.29	-	-	24.80	-	-	102	-	88	-
Boston fire promotion, . . .	-	-	9	9	-	-	9	-	-	16	1	-	-	33.56	-	-	-	-	-	9	-	-	-
District police service, . . .	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
Boston police service, . . .	4	-	-	415	-	-	265	-	-	105	-	-	1	27.89	-	-	28.83	-	-	265	-	150	-
Boston police promotion, . . .	-	-	10	10	-	-	10	-	-	14	2	-	-	41.10	-	-	-	-	-	10	-	-	-
Other cities, police service, . .	28	-	-	498	-	-	358	-	-	126	-	-	7	29.46	-	-	30.80	-	-	356	2	140	-
Other cities, police promotion, .	-	-	10	10	-	-	10	-	-	11	-	-	2	44.47	-	-	-	-	-	10	-	-	-

Boston drawtender service,	1	-	-	19	-	-	15	-	-	14	-	-	-	33.53	-	-	48.00	-	-	15	-	4	-
Other cities, drawtender service,	1	-	-	5	-	-	5	-	-	1	-	-	-	36.60	-	-	-	-	-	5	-	-	-
Boston foreman and sub-foreman service.	4	-	-	47	8	-	37	1	-	-	1	-	-	35.08	55.00	-	36.40	55.50	-	38	-	12	-
State foreman and inspection service.	2	-	-	16	2	-	14	2	-	11	2	-	2	38.00	59.50	-	34.50	-	-	16	-	2	-
Boston inspection service,	8	-	-	108	4	-	59	8	-	25	-	-	2	34.78	59.00	-	35.66	54.00	-	60	2	45	-
Boston inspection promotion,	-	-	1	1	-	-	1	-	-	1	-	-	-	33.00	-	-	-	-	-	1	-	-	-
Other cities, foreman and inspection service.	19	-	-	104	8	-	78	7	-	32	2	-	6	40.05	57.92	-	39.31	62.00	-	80	5	26	1
*Other cities and towns, plumbing inspection service.	-	-	17	17	-	-	6	-	-	4	-	-	-	37.17	-	-	36.76	-	-	6	-	8	8
*Boston plumbing and gas fitting inspection service.	-	-	2	2	-	-	2	-	-	2	-	-	-	34.50	-	-	-	-	-	2	-	-	-
Boston school janitor service,	1	-	-	40	1	1	21	1	1	12	1	-	2	37.90	54.00	35.00	42.32	-	-	23	-	19	-
Other cities, school janitor service,	1	1	-	7	1	-	2	1	-	1	-	-	-	45.00	-	-	46.40	59.00	-	8	-	5	-
Other cities, fire service,	5	-	-	83	-	-	64	-	-	19	-	-	1	26.54	-	-	29.80	-	-	64	-	19	-
Other cities, fire promotion,	-	-	2	2	-	-	2	-	-	2	-	-	-	32.00	-	-	-	-	-	2	-	-	-
Boston truant officer service,	1	-	-	32	-	-	28	-	-	2	-	-	1	35.89	-	-	38.00	-	-	28	-	4	-
Boston civil engineering service,	8	-	-	68	-	-	47	-	-	24	-	-	-	24.43	-	-	23.43	-	-	28	19	20	1
Boston civil engineering promotion,	-	-	4	4	-	-	4	-	-	8	-	-	-	27.25	-	-	-	-	-	4	-	-	-
Other cities, civil engineering service.	22	-	-	47	-	-	34	-	1	18	-	-	-	22.55	-	-	22.57	-	-	26	9	10	2
Other cities, civil engineering promotion	-	-	3	3	-	-	2	-	-	2	-	-	-	35.40	-	-	34.00	-	-	1	1	1	-
Other cities, superintendent service,	-	1	-	1	1	-	1	-	-	-	-	-	1	39.00	-	-	-	57.00	-	1	-	1	-
Aids to State Fire Marshal service,	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
	149	8	66	2,241	47	565	1,467	21	416	557	10	100	41	31.86	57.24	24.81	32.11	57.65	25.38	1,834	70	928	21
	218			2,853			1,904			667			41	37.97			38.38			1,904		949	

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* The non-competitive examinations of inspectors of plumbing and gas fittings are held in accordance with chapter 455 of the Acts of 1894 and chapter 265 of the Acts of 1897.

NON-COMPETITIVE EXAMINATIONS.

During the year there have been held 2 non-competitive examinations for original appointment to positions within the civil service classification, as follows: —

One clerk, where the special qualifications required were a knowledge of historical and genealogical work.

One clerk, where the special qualifications required were a knowledge of statistics, French, German and proof-reading.

Respectfully submitted,

WARREN P. DUDLEY,
Secretary.

HENRY SHERWIN,
Chief Examiner.

LABOR SERVICE IN BOSTON.

During the year ending Sept. 30, 1901, 204 requisitions for laborers and mechanics were received from the several departments of the city of Boston. Of these requisitions, 66 were subsequently cancelled, upon which had been certified 561 names, 153 being those of veterans and 408 those of others who were not veterans.

Whole number of applications received,		3,400
Number of names restored from previous years,	2,158	
Applicants registered during the year,	1,242	
Whole number of persons registered,	——	3,400
Number registered with credit as veterans,	124	
Number registered without credit as veterans,	3,276	
	——	3,400
Percentage registered having credit as veterans,	4	
Percentage registered without credit as veterans,	96	
Number of requisitions received,	204	
Number of persons certified once,	876 =	876
Number of persons certified twice,	280 =	560
Number of persons certified three times,	71 =	213
Number of persons certified four times,	43 =	172
Number of persons certified five times,	1 =	5
Number of persons certified six times,	2 =	12
Number of persons certified seven times,	2 =	14
Number of persons certified eight times,	1 =	8
	——	——
Whole number of persons certified,	1,276	
Whole number of certifications,		1,860

Of the whole number of certifications there were of veterans, ... 227, or 12.2 per cent.

Of the whole number of certifications there were of others, not veterans, ... 1,634, or 87.8 per cent.

Number of persons employed (veterans),	21	
Number of persons employed (not veterans),	373	
		394
Percentage employed of veterans registered,		16.94
Percentage employed of others (not veterans) registered,		11.39
Percentage employed of whole number registered,		11.59
Percentage employed of veterans certified,		9.25
Percentage employed of others (not veterans) certified,		22.83
Percentage employed of whole number certified,		21.17

DISCHARGES.

DEPARTMENTS.	Lack of Work.	Resigned and withdrew.	Bad Habits.	Incompetent and Unsatisfactory.	Died.	Failed to report and declined.	Transferred to Other Departments.	Not having been employed for Six Months.	By Order of Civil Service Commission.	For Promotion.	Total discharged.
Street,	1	3	4	3	34	-	1	348	-	1	394
Water,	2	6	-	4	16	-	1	27	-	1	56
Pauper institutions,	11	9	1	5	-	1	2	1	-	-	28
Cemeteries,	-	-	-	-	-	-	-	9	-	-	9
Public grounds,	-	1	-	-	-	-	18	34	-	-	35
Public buildings,	-	-	-	-	-	-	-	37	-	-	37
Park,	1	1	-	1	1	-	21	43	-	-	47
Hospital,	2	-	-	2	-	-	1	-	-	-	4
Baths,	-	-	-	-	7	-	1	-	-	-	7
Health,	-	1	-	-	-	-	-	-	-	-	1
Fire,	-	-	1	-	-	-	-	-	-	1	2
Children's institutions,	-	1	-	-	-	-	-	-	-	-	1
Insane hospital,	-	1	-	-	-	-	1	-	-	-	1
Police,	-	-	-	-	-	1	-	-	-	-	1
Totals,	17	23	6	15	58	2	46	499	-	3	623

RECAPITULATION.

DEPARTMENTS.	Requisitions.	Number of Men called for.	NUMBER OF MEN CERTIFIED, 1900-1901.		Total Number certified.	NUMBER OF MEN EMPLOYED DURING THE YEAR ENDING SEPT. 30, 1901.				
						FROM REGISTER OF 1900-1901.		Restored from Previous Rolls.	Transferred from Other Departments.	Totals.
			Veterans.	Others.		Veterans.	Others.			
Street,	98	566	118	1,202	1,320	9	222	1	36	268
Water,	6	6	3	5	8	3	3	6	4	16
Pauper institutions,	27	32	21	100	121	-	22	-	1	23
Cemeteries,	13	27	5	46	51	-	17	-	-	17
Public grounds,	12	100	6	149	155	-	53	-	-	53
Public buildings,	4	4	5	3	8	1	1	-	-	2
Park,	18	29	-	59	59	-	23	1	2	26
Hospital,	2	5	18	1	19	3	1	-	-	4
Baths,	8	22	1	36	37	-	16	-	1	17
Health,	4	5	-	8	8	-	5	-	1	6
Fire,	2	4	5	8	13	-	5	-	-	5
Children's institutions,	5	11	35	8	43	1	2	-	1	4
Insane hospital,	2	3	2	9	11	1	3	-	-	4
Police,	3	3	8	-	8	3	-	-	-	3
Totals,	204	817	227	1,634	1,861	21	373	8	46	448

The several registration clerks in the cities outside of Boston, where the civil service labor rules apply, have filed reports of the work in their respective cities, which are hereto annexed.

Respectfully submitted,

WILLIAM L. HICKS,
Registrar of Labor.

LABOR SERVICE IN WORCESTER.

To WILLIAM L. HICKS, *Registrar of Labor, Civil Service Commission, State House, Boston, Mass.*

SIR: — I herewith submit a full and complete report of the business of my office for the year ending Sept. 30, 1901.

Whole number of applications received,		1,515
Number of names restored from previous years,	549	
Applicants registered during the year,	966	
Whole number of persons registered,		1,515
Number registered with credit as veterans,	16	
Number registered without credit as veterans,	1,499	
		1,515
Percentage registered having credit as veterans,	1.06	
Percentage registered without credit as veterans,	98.94	
Number of requisitions received,	71	
Number of persons certified once,	1,111 =	1,111
Number of persons certified twice,	220 =	440
Number of persons certified three times,	24 =	72
Number of persons certified four times,	4 =	16
Whole number of persons certified,	1,359	
Whole number of certifications,		1,639

Of the whole number of certifications there were of veterans, ... 12, or .73 per cent.

Of the whole number of certifications there were of others, not veterans, ... 1,627, or 99.27 per cent.

Number of persons employed (veterans),	10	
Number of persons employed (not veterans),	1,473	
		1,483
Percentage employed of veterans registered,		62.50
Percentage employed of others (not veterans) registered,		98.27
Percentage employed of whole number registered,		97.89
Percentage employed of veterans certified,		83.33⅓
Percentage employed of others (not veterans) certified,		90.53
Percentage employed of whole number certified,		90.48

DISCHARGES.

DEPARTMENTS.	Lack of Work.	Resigned and withdrew.	Bad Habits.	Incompetent and Unsatisfactory.	Died.	Failed to report and declined.	Transferred to Other Departments.	Not having been employed for Six Months.	By Order of Civil Service Commission.	For Promotion.	Total discharged.
Buildings,	-	-	-	-	-	-	-	-	-	-	-
City hall,	-	-	-	-	-	-	-	-	-	-	-
Parks,	14	-	-	-	-	-	-	-	-	-	14
Sewer,	-	39	7	3	-	56	-	109	-	-	214
Street,	-	-	-	-	-	-	-	-	-	-	-
Water,	44	354	30	24	2	294	-	83	-	-	831
Totals,	58	393	37	27	2	350	-	192	-	-	1,059

RECAPITULATION.

DEPARTMENTS.	Requisitions.	Number of Men called for.	NUMBER OF MEN CERTIFIED, 1900 1901.		Total Number certified.	NUMBER OF MEN EMPLOYED DURING THE YEAR ENDING SEPT. 30, 1901.				
						FROM REGISTER OF 1900-1901.		Restored from Previous Rolls.	Transferred from Other Departments.	Totals.
			Veterans.	Others.		Veterans.	Others.			
Buildings,	1	1	-	1	1	-	1	-	-	1
City hall,	-	-	-	-	-	-	-	-	-	-
Parks,	2	14	-	20	20	-	14	-	-	14
Sewer,	19	221	3	366	369	2	264	-	-	266
Street,	7	25	5	38	43	5	23	-	-	28
Water,	42	960	4	1,202	1,206	3	1,171	-	-	1,174
Totals,	71	1,221	12	1,627	1,639	10	1,473	-	-	1,483

Respectfully,

WILLIAM B. CONNOR,
Registration Clerk.

LABOR SERVICE IN CAMBRIDGE.

To WILLIAM L. HICKS, *Registrar of Labor, Civil Service Commission, State House, Boston, Mass.*

SIR: — I herewith submit a full and complete report of the business of my office for the year ending Sept. 30, 1901.

Whole number of applications received,		676
Number of names restored from previous years,	370	
Applicants registered during the year,	306	
Whole number of persons registered,		676
Number registered with credit as veterans,	17	
Number registered without credit as veterans,	659	
		676
Percentage registered having credit as veterans,	2.51	
Percentage registered without credit as veterans,	97.49	
Number of requisitions received,	32	
Number of persons certified once,	391 =	391
Number of persons certified twice,	88 =	176
Number of persons certified three times,	20 =	60
Number of persons certified four times,	1 =	4
Whole number of persons certified,	500	
Whole number of certifications,		631

Of the whole number of certifications there were of veterans, ... 17, or 2.69 per cent.

Of the whole number of certifications there were of others, not veterans, ... 614, or 97.31 per cent.

Number of persons employed (veterans),	12	
Number of persons employed (not veterans),	229	
		241
Percentage employed of veterans registered,		70.58
Percentage employed of others (not veterans) registered,		34.74
Percentage employed of whole number registered,		35.65
Percentage employed of veterans certified,		70.58
Percentage employed of others (not veterans) certified,		37.29
Percentage employed of whole number certified,		38.19

DISCHARGES.

DEPARTMENTS.	Lack of Work.	Resigned and withdrew.	Bad Habits.	Incompetent and Unsatisfactory.	Died.	Failed to report and declined.	Transferred to Other Departments.	Not having been employed for Six Months.	By Order of Civil Service Commission.	For Promotion.	Total discharged.
Cemetery, ...	5	-	-	4	-	-	-	-	-	-	9
City home (almshouse), . .	-	-	-	-	1	-	-	-	-	-	1
Park, ...	-	7	-	-	-	-	-	40	-	-	47
Sewer, ...	2	14	-	-	-	-	-	1	-	-	17
Street, ...	57	7	6	13	2	-	-	16	-	-	101
Water, ...	-	20	-	-	1	-	-	-	-	-	21
Totals, ...	64	48	6	17	4	-	-	57	-	-	196

RECAPITULATION.

DEPARTMENTS.	Requisitions.	Number of Men called for.	Number of Men certified, 1900-1901.		Total Number certified.	Number of Men employed during the Year ending Sept. 30, 1901.				
						From register of 1900-1901.		Restored from Previous Rolls.	Transferred from Other Departments.	Totals.
			Veterans.	Others.		Veterans.	Others.			
Cemetery,	2	6	1	10	11	1	7	-	-	8
City home (almshouse),	4	11	-	12	12	-	5	-	-	5
Health,	1	1	-	1	1	-	1	-	-	1
Park,	11	40	-	74	74	-	36	-	-	36
Police (drivers, patrol),	-	-	-	-	-	-	-	-	-	-
Police (drivers, ambulance),	-	-	-	-	-	-	-	-	-	-
Public property (schools),	2	2	-	4	4	-	1	-	-	1
Sewers,	1	10	-	20	20	-	5	-	-	5
Street,	7	113	10	204	214	9	101	-	-	110
Water,	4	151	6	289	295	2	73	-	-	75
Totals,	32	334	17	614	631	12	229	-	-	241

Respectfully,

HARRY L. LINCOLN,

Registration Clerk.

LABOR SERVICE IN NEW BEDFORD.

To WILLIAM L. HICKS, *Registrar of Labor, Civil Service Commission,*
State House, Boston, Mass.

SIR: — I herewith submit a full and complete report of the business of my office for the year ending Sept. 30, 1901.

Whole number of applications received,		264
Number of names restored from previous years,	67	
Applicants registered during the year,	197	
Whole number of persons registered,		264
Number registered with credit as veterans,	8	
Number registered without credit as veterans,	256	
		264
Percentage registered having credit as veterans,	3.03	
Percentage registered without credit as veterans,	96.97	
Number of requisitions received,	65	
Number of persons certified once,	183 =	183
Number of persons certified twice,	45 =	90
Number of persons certified three times,	17 =	51
Number of persons certified four times,	1 =	4
Whole number of persons certified,	246	
Whole number of certifications,		328

Of the whole number of certifications there were of veterans, ... 8, or 2.44 per cent.

Of the whole number of certifications there were of others, not veterans, ... 320, or 97.56 per cent.

Number of persons employed (veterans),	8	
Number of persons employed (not veterans),	124	
		132
Percentage employed of veterans registered,		100.00
Percentage employed of others (not veterans) registered,		48.43
Percentage employed of whole number registered,		50.00
Percentage employed of veterans certified,		100.00
Percentage employed of others (not veterans) certified,		38.75
Percentage employed of whole number certified,		40.24

DISCHARGES.

DEPARTMENTS.	Lack of Work.	Resigned and withdrew.	Bad Habits.	Incompetent and Unsatisfactory.	Died.	Failed to report and declined.	Transferred to Other Departments.	Not having been employed for Six Months.	By Order of Civil Service Commission.	For Promotion.	Total discharged.
Public works,	-	-	2	-	2	9	3	58	-	-	74
Cemetery,	-	-	2	-	-	1	1	4	-	-	8
Water,	-	1	1	-	-	-	1	-	-	-	3
Poor,	-	-	-	-	-	-	-	-	-	-	-
Park,	1	1	-	-	2	1	2	24	-	-	31
Totals,	1	2	5	-	4	11	7	86	-	-	116

RECAPITULATION.

DEPARTMENTS.	Requisitions.	Number of Men called for.	NUMBER OF MEN CERTIFIED, 1900-1901.		Total Number certified.	NUMBER OF MEN EMPLOYED DURING THE YEAR ENDING SEPT. 30, 1901.				
						FROM REGISTER OF 1900-1901.		Restored from Previous Rolls.	Transferred from Other Departments.	Totals.
			Veterans.	Others.		Veterans.	Others.			
Public works,	57	125	5	306	311	5	119	-	3	127
Cemetery,	2	2	1	2	3	1	1	-	1	3
Water,	-	-	-	-	-	-	-	-	1	1
Poor,	-	-	-	-	-	-	-	-	-	-
Park,	6	7	2	12	14	2	4	-	2	8
Totals,	65	134	8	320	328	8	124	-	7	139

Respectfully,

GEO. P. BROCK,
Registration Clerk.

LABOR SERVICE IN NEWTON.

To WILLIAM L. HICKS, *Registrar of Labor, Civil Service Commission State House, Boston, Mass.*

SIR: — I herewith submit a full and complete report of the business of my office for the year ending Sept. 30, 1901.

The whole number of applications received during the year was 112, including the names of 48 persons restored from previous years.

No veterans have applied for registration during the current year.

There have been 9 requisitions received, of which 8 were from the street department and 1 from the police department; these requisitions called for 52 names, and upon them 91 names were certified.

From the lists of names certified 29 persons were selected for employment, 28 in the street department and 1 in the police department.

But 1 name has been dropped from the list of employees during the year, and that because of bad habits.

Respectfully submitted,

THEODORE A. FLEU,
Registration Clerk.

LABOR SERVICE IN EVERETT.

To William L. Hicks, *Registrar of Labor, Civil Service Commission, State House, Boston, Mass.*

Sir: — I herewith submit a full and complete report of the business of my office for the year ending Sept. 30, 1901.

Whole number of applications received,		290
Number of names restored from previous years,	89	
Applicants registered during the year,	201	
Whole number of persons registered,		290
Number registered with credit as veterans,	11	
Number registered without credit as veterans,	279	
		290
Percentage registered having credit as veterans,	3.79	
Percentage registered without credit as veterans,	96.21	
Number of requisitions received,	42	
Number of persons certified once,	163 =	163
Number of persons certified twice,	60 =	120
Number of persons certified three times,	26 =	78
Number of persons certified four times,	12 =	48
Number of persons certified five times,	2 =	10
Whole number of persons certified,	263	
Whole number of certifications,		419

Of the whole number of certifications there were of veterans, ... 12, or 2.86 per cent.

Of the whole number of certifications there were of others, not veterans, ... 407, or 97.14 per cent.

Number of persons employed (veterans),	9	
Number of persons employed (not veterans),	193	
		202
Percentage employed of veterans registered,		81.81
Percentage employed of others (not veterans) registered,		69.17
Percentage employed of whole number registered,		69.65
Percentage employed of veterans certified,		75.00
Percentage employed of others (not veterans) certified,		47.42
Percentage employed of whole number certified,		48.21

DISCHARGES.

DEPARTMENTS.	Lack of Work.	Resigned and withdrew.	Bad Habits.	Incompetent and Unsatisfactory.	Died.	Failed to report and declined.	Transferred to Other Departments.	Not having been employed for Six Months.	By Order of Civil Service Commission.	For Promotion.	Total discharged.
Board of public works, . .	-	-	-	-	1	41	-	1	-	-	43

RECAPITULATION.

DEPARTMENTS.	Requisitions.	Number of Men called for.	NUMBER OF MEN CERTIFIED, 1900-1901.		Total Number certified.	NUMBER OF MEN EMPLOYED DURING THE YEAR ENDING SEPT. 30, 1901.				
						FROM REGISTER OF 1900-1901.		Restored from Previous Rolls.	Transferred from Other Departments.	Total.
			Veterans.	Others.		Veterans.	Others.			
Board of public works, ...	42	275	12	407	419	9	193	-	-	202

Respectfully,

LEONARD F. GLAVIN,
Registration Clerk.

Commonwealth of Massachusetts.

[REVISED LAWS, CHAPTER 19.]

OF THE CIVIL SERVICE.

CIVIL SERVICE COMMISSION AND OFFICERS.

Civil service commission. 1884, 320, § 1. 138 Mass. 603.

SECTION 1. The governor shall annually, in May or June, with the advice and consent of the council, appoint a civil service commissioner for a term of three years from the first Monday of July following. All appointments shall be so made that not more than two commissioners shall at the time of any appointment be members of the same political party. Each commissioner shall be paid five dollars for each day's service and his travelling and other expenses incurred in the performance of his official duties.

Chief examiner, secretary, etc. 1884, 320, § 20. 1888, 41. 1889, 177, 351. 1895, 376. [1 Op. A. G. 382.]

SECTION 2. The commissioners may appoint a chief examiner, who, under their direction, shall superintend any examination held under the provisions of this chapter and perform such other duties as they may prescribe. He shall receive an annual salary of three thousand dollars, and travelling expenses incurred in the performance of his official duties. They may appoint a secretary who shall receive an annual salary of two thousand dollars. They may appoint a registrar of labor, who shall, under their direction, supervise the administration of civil service rules applicable to the public labor service of the commonwealth or of any city thereof. He shall receive an annual salary of two thousand dollars, and his travelling expenses. They may incur other expenses not exceeding the annual appropriation therefor.

Witnesses and testimony. 1891, 140.

SECTION 3. The commissioners or any of them, in an investigation by them, may summon witnesses, administer oaths and take testimony. The fees of such witnesses shall be the same as for witnesses before the superior court, and shall be paid from the appropriation for the incidental expenses of the commissioners.

Examiners.
1884, 320, § 20.

SECTION 4. They may designate persons in the official service of the commonwealth or of any city or of any town wherein this chapter is in force, who shall, with the consent of the head of department or office in which any such person serves, act as examiners of applicants for public employment. But no person shall serve as such examiner when any relative or connection by marriage, within the degree of first cousin, shall be an applicant.

Records and annual report.
1884, 320, §§ 2, 23.

SECTION 5. They shall keep records of their proceedings and of examinations made by them or under their authority. Recommendations of applicants received by them or by any officer authorized to make appointments or to employ laborers or others, within the scope of such rules, shall be preserved. Such records and recommendations shall, under regulations approved by the governor and council, be open to public inspection. The commissioners shall from time to time suggest to the general court appropriate legislation for the administration and improvement of the civil service and shall annually before the tenth day of January make a report which shall contain any rules adopted under the provisions of this chapter.

RULES.

Rules.
1884, 320, § 2.
143 Mass. 589.
145 Mass. 587, 589.

SECTION 6. The commissioners shall from time to time prepare rules regulating the selection of persons to fill appointive positions in the government of the commonwealth and of the several cities thereof and the selection of persons to be employed as laborers or otherwise in the service of the commonwealth and said several cities, and altering, rescinding, amending or adding to the rules now established. Such rules may be of general or limited application and shall take effect only when approved by the governor and council.

Application of rules.
1884, 320, § 14.
1895, 501, § 1.
1896, 517, § 8.
138 Mass. 603.
145 Mass. 590.

SECTION 7. The rules heretofore prepared by the commissioners and now in force shall continue in force, and such rules, and those hereafter prepared by them and approved by the governor and council shall be administered by the commissioners. They shall not be inconsistent with law, may be of general or limited application and shall include provisions for: —

The classification of the positions and employments to be filled.

Open competitive and other examinations to test the practical fitness of applicants.

The filling of vacancies in and the selection of persons for public positions and employments in accordance with the results of such examinations, or in the order of application, or otherwise.

Promotions, if practicable, on the basis of ascertained merit in the examination and seniority of service.

A period of probation before an appointment or employment is made permanent.

Preference to veterans in appointment and promotion.

Printing and distribution of rules.
1884, 320, § 19.
1888, 253.

SECTION 8. Changes in the rules shall forthwith, when approved, be printed for distribution, and a certified copy thereof sent to the mayor of each city and the selectmen of each town to which such changes relate, and shall be published in one or more newspapers. In such publication the date when such changes shall take effect shall be specified, which date shall be not less than sixty days subsequent to the date of such publication.

Officers not affected.
1884, 320, § 15.
1893, 95.
1896, 502.
[1 Op. A. G. 72, 194.]

SECTION 9. Judicial officers and officers elected by the people or by a city council, or whose appointment is subject to confirmation by the executive council or city council of any city, officers elected by either branch of the general court and the appointees of such officers, heads of principal departments of the commonwealth or of a city, the employees of the treasurer and receiver general, of the board of commissioners of savings banks, and of the treasurer and collector of taxes of any city, two employees of the city clerk of any city, teachers of the public schools, the secretaries and confidential stenographers of the governor, or of the mayor of any city, police and fire commissioners and chief marshals or chiefs of police and fire departments, shall not be affected as to their selection or appointment by any rules made as aforesaid; but, with the above exception, such rules shall apply to members of police and fire departments.

SPECIAL PROVISIONS APPLICABLE TO BOSTON.

Classification of janitors, etc., in charge of steam boilers in school houses in Boston.
1889, 352.
1893, 258.

SECTION 10. Engineers, janitors and all persons having charge of steam boilers and furnaces in the school buildings in the city of Boston, and truant officers appointed by the school committee of said city, shall be classified and appointed pursuant to this chapter and the rules thereunder.

Qualifications of firemen in Boston.
Placing on list for permanent appointment.
1896, 256, 424.

SECTION 11. Persons five feet five inches in height or over, if otherwise qualified, shall be eligible to appointment in the fire department of the city of Boston. Call members in said department who have served three or more successive years shall, upon application to the civil service commissioners, be placed upon the eligible list for appointment as permanent men without further examination, and may at the discretion of the fire commissioner be appointed at the same salary as permanent men who have served three or more years in said service.

APPLICATIONS.

Statements of applicants for examination.
1884, 320, § 17.
1889, 183.
145 Mass. 587, 589.

SECTION 12. Every application shall state under oath the full name, residence and post office address, citizenship, age, place of birth, health and physical capacity, right of preference as a veteran, previous employment in the public service, business or employment and residence for the previous five years, and education of the applicant, and such other information as may reasonably be required relative to his fitness for the public service.

Application for registry in labor service.
1897, 328.

Applicants for positions in the labor service of the commonwealth or of the cities thereof shall, to the number of five hundred, be allowed to register on the first Monday of February, May, August and November in each year, at the places appointed therefor.

EXAMINATIONS AND LISTS.

Scope of examination.
1884, 320, § 16.

SECTION 13. No question in any examination shall relate to, and no appointment to a position or selection for employment shall be affected by, political or religious opinions or affiliations. Examinations shall be practical and shall relate to matters which will fairly test the capacity and fitness of the applicants. The examination of applicants for employment as laborers shall relate to their capacity for labor and habits of sobriety and industry and to the necessities of themselves and their families.

Obstruction of right of examination forbidden.
1884, 320, § 80.

SECTION 14. No person in the public service shall wilfully and corruptly defeat, deceive or obstruct any person as to his right of examination; or wilfully or corruptly make a false mark, grade, estimate or report upon the examination or proper standing of any person examined hereunder, or aid in so doing; or wilfully or corruptly make any false representation concerning the same or concerning the person examined; or wilfully or corruptly furnish to a person special or secret information, for the purpose of improving or injuring the prospects or chances of appointment, employment or promotion of any person so examined or to be examined.

Lists of names of successful applicants.
1895, 501, § 4.
1896, 517, § 4.

SECTION 15. The commissioners, within five days after the results of an examination have been ascertained, shall prepare a list of the applicants who have passed the examination, with the standing of each; and, within five days after certification of persons for appointment or employment, prepare a list of the persons so certified which shall be open to public inspection.

APPOINTMENTS.

Vendor or user of liquor ineligible.
1884, 320, § 3.

SECTION 16. No person habitually using intoxicating liquors to excess and no vendor of intoxicating liquors shall be appointed to or retained in any office, appointment or employment to which the provisions of this chapter apply.

Convicts ineligible for one year.
1884, 320, § 4.
1888, 334.
[1 Op. A. G. 243.]

SECTION 17. No person shall be appointed to or employed in any office to which the provisions of this chapter apply within one year after his conviction of any crime against the laws of this commonwealth.

Recommendations of public officers restricted.
1884, 320, § 5.

SECTION 18. No recommendation of an applicant for a position or employment under the provisions of this chapter given by any member of the general court, alderman or councilman, except as to the character or residence of the applicant, shall be received or considered by any person concerned in making the appointment under this chapter.

Name, etc., of appointees to be reported to commissioners.
1884, 320, § 22.

SECTION 19. The name and residence of every person, except laborers, appointed to, promoted or employed in a position coming within the rules governing the civil service, the designation of such position and the rejection or discharge of every such person, shall forthwith be reported to the commissioners by the officer making such appointment, promotion, rejection or discharge, or providing such employment.

VETERANS' PREFERENCE.

Definition of "veteran."
1896, 517, §§ 1, 6.

SECTION 20. The word "veteran" in this chapter shall mean a person who has served in the army or navy of the United States in the war of the rebellion and was honorably discharged therefrom, or a citizen of this commonwealth who distinguished himself by gallant and heroic conduct while serving in the army or navy of the United States and has received a medal of honor from the president of the United States.

Application of veterans for examination.
1887, 437.
1889, 473.
1895, 501, §§ 1–3, 6.
1896, 517, § 2.
145 Mass. 587.
166 Mass. 14, 589.
[1 Op. A. G. 243, 340.]

SECTION 21. A veteran may apply for examination under the rules, and if he passes the examination, shall be preferred in appointment and employment to all persons not veterans. The commissioners shall cause the names of the veterans who pass the examination to be placed upon the eligible list in the order of their respective standing, above the names of all other applicants, and to be certified to the appointing officers for appointment and employment in preference to other applicants, and the appointment or employment shall be made from the list so certified. But nothing herein shall prevent the certification and employment of women.

Application for employment.
1896, 517, § 3.
166 Mass. 589.

SECTION 22. A veteran may apply for appointment to or for employment in the classified public service without examination. In such application, he shall state under oath the facts required by the rules. Age, loss of limb or other disability which does not in fact incapacitate shall not disqualify him for appointment or employment under the provisions of this section. Appointing officers may make requisition for the names of any or all such veterans and appoint or employ any of them.

Removal of veteran only after hearing.
1894, 519.
1896, 517, § 5.
1901, 339.
175 Mass. 489.

SECTION 23. No veteran who holds an office or employment in the public service of the commonwealth, or of any city or town therein, shall be removed or suspended, or shall, without his consent, be transferred from such office or employment, nor shall his office be abolished, except after a full hearing of which he shall have at least seventy-two hours' written notice, with a statement of the reasons for the contemplated removal, suspension, transfer or abolition. The hearing shall be before the state board of conciliation and arbitration, if the veteran is a state employee, or before the mayor of the city or selectmen of the town of which he is an employee, and the veteran shall have the right to be present and to be represented by counsel. Such removal, suspension or transfer, or such abolition of an office, shall be made only upon a written order stating fully and specifically the cause or causes therefor, and signed by said board, mayor or selectmen, after a hearing as aforesaid.

Rules for veterans.
1896, 517, § 6.
166 Mass. 589.
170 Mass. 58.

SECTION 24. The rules shall provide for the employment of veterans in the labor service of the commonwealth and of the cities and towns thereof, in the class for which they make the same or concerning the person examined; or wilfully or corruptly furnish to a person special or secret information, for the purpose of improving or injuring the prospects or chances of appointment, employment or promotion of any person so examined or to be examined.

Lists of names of successful applicants. 1895, 501, § 4. 1896, 517, § 4.

SECTION 15. The commissioners, within five days after the results of an examination have been ascertained, shall prepare a list of the applicants who have passed the examination, with the standing of each; and, within five days after certification of persons for appointment or employment, prepare a list of the persons so certified which shall be open to public inspection.

APPOINTMENTS.

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Convicts ineligible for one year. 1884, 320, § 4. 1888, 334. [1 Op. A. G. 243.]

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Application for employment.
1896, 517, § 3.
166 Mass. 589.

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Removal of veteran only after hearing.
1894, 519.
1896, 517, § 5.
1901, 339.
175 Mass. 489.

SECTION 23. No veteran who holds an office or employment in the public service of the commonwealth, or of any city or town therein, shall be removed or suspended, or shall, without his consent, be transferred from such office or employment, nor shall his office be abolished, except after a full hearing of which he shall have at least seventy-two hours' written notice, with a statement of the reasons for the contemplated removal, suspension, transfer or abolition. The hearing shall be before the state board of conciliation and arbitration, if the veteran is a state employee, or before the mayor of the city or selectmen of the town of which he is an employee, and the veteran shall have the right to be present and to be represented by counsel. Such removal, suspension or transfer, or such abolition of an office, shall be made only upon a written order stating fully and specifically the cause or causes therefor, and signed by said board, mayor or selectmen, after a hearing as aforesaid.

Rules for veterans.
1896, 517, § 6.
166 Mass. 589.
170 Mass. 58.

SECTION 24. The rules shall provide for the employment of veterans in the labor service of the commonwealth and of the cities and towns thereof, in the class for which they make application, in preference to all other persons except women. If the appointing officer certifies in his requisition for laborers that the work to be performed requires young and vigorous men, and, upon investigation, the commissioners are satisfied that such certificate is true, they may fix a limit of age and certify only those whose age falls within such limit. In cities and towns in which the provisions of this chapter and the rules governing the civil service have not been applied to the labor service, the selectmen and the city councils shall take any necessary action to secure the employment of veterans in the labor service of their respective cities and towns in preference to all other persons except women.

Reinstatement of certain persons. 1898, 454.

SECTION 25. Any person in the classified public service of the commonwealth or of any city or town thereof who resigns such office or leaves such service for the purpose of enlisting and serving in the army or navy of the United States or in the militia of this commonwealth in time of war and so enlists and serves, may at any time within one year after his honorable discharge from such military or naval service be appointed to or employed in his former or a similar position or employment, without application or examination.

CORRUPT PRACTICES.

Public officers not to solicit contributions for political purposes. 1884, 320, § 6.

SECTION 26. No councillor, member of the general court, alderman or councilman, or any officer or employee of any of said bodies, and no executive or judicial officer of the commonwealth, no clerk or employee of any department or branch of the government of the commonwealth and no executive officer, clerk or employee of any department of a city shall personally solicit or receive, directly or indirectly, or be concerned in soliciting or receiving, any assessment, subscription or contribution for any political purpose whatever; but this shall not forbid such persons to be members of political organizations or committees.

Solicitations forbidden in official buildings. 1884, 320, § 7

SECTION 27. No person shall solicit in any manner whatever or receive any contribution of money or other thing of value for any political purpose whatever in a room or building occupied for the performance of official duties by an officer or employee of the commonwealth or of any city herein.

Public officers, etc., not to be affected by

SECTION 28. No officer or employee of the commonwealth or of any city or town wherein this chapter is in force, shall discharge, promote, or degrade an officer or employee, or change his official rank or compensation, or promise or threaten so to do, for giving, withholding or neglecting to make a contribution of money or other valuable thing for a political purpose.

refusal to contribute.
1884, 320, § 8.
142 Mass. 90, 95.

SECTION 29. No officer, clerk or other person in the service of the commonwealth or of any city or town wherein this chapter is in force shall, directly or indirectly, give or deliver to an officer, clerk or person in said service, or to any councillor, member of the general court, alderman, councilman or commissioner, any money or other valuable thing on account of, or to be applied to, the promotion of any political object whatever.

Gifts for political object forbidden.
1884, 320, § 9.

SECTION 30. No person in the service of the commonwealth or of any city or town wherein this chapter is in force shall use his official authority or influence to coerce the political action of any person or body, or to interfere with any election.

Coercion of political action forbidden.
1884, 320, § 10.

SECTION 31. No person in the public service shall, for that reason, be under obligation to contribute to any political fund, or to render any political service, and shall not be removed or otherwise prejudiced for refusing to do so.

Public officers, etc., not required to contribute to political fund.
1884, 320, § 11.
142 Mass. 90, 95.

SECTION 32. No person holding a public office or in nomination for, or seeking a nomination for, or appointment to, an office, shall corruptly use or promise to use, directly or indirectly, any official authority or influence to confer upon any person, or to aid a person to obtain, an office or public employment, or a nomination, confirmation, promotion or increase of salary, upon the consideration or condition that the vote, political influence or action of any person shall be given or used in behalf of a candidate, officer or party, or upon any other corrupt condition or consideration.

Corrupt methods of procuring nominations, etc., prohibited.
1884, 320, § 12.

SECTION 33. No city shall pay a bill incurred by any official thereof for wines, liquors or cigars; nor shall a city pay a bill for refreshments furnished to an official of said city if the amount for any one day exceeds one dollar for each member of the government of said city who certifies over his own signature to the correctness of the bill.

Refreshments at public expense regulated.
1884, 320, § 13.

GENERAL PROVISIONS.

SECTION 34. If, in the opinion of the civil service commissioners, a person is appointed or employed in the public service classified under civil service rules in violation of any such rules, the commissioners shall, after written notice mailed to the

Enforcement of rules.
1901, 512.

appointing or employing officer or officers and to such person, notify in writing the treasurer, auditor or other disbursing officer of the commonwealth, city or town in whose service such person is so employed, and the payment of any compensation to such person shall be illegal and shall cease at the expiration of one week after the mailing of the latter notice, until the legality of such appointment or employment is duly established. The attorney general may, within thirty days after said notice to such treasurer, auditor or other disbursing officer, file in the superior court, sitting in equity for the county in which such appointee or employee was appointed or employed, an information in the nature of a quo warranto against such appointee or employee, and the superior court or any justice thereof shall have jurisdiction to hear and determine the same. At any time after the beginning of such proceedings the court may, if it is of opinion that there is reasonable doubt whether the employment of such person is in violation of such rules, order that the compensation accruing to the person notified shall be paid to him until otherwise ordered by said court. If the attorney general shall fail within said thirty days to file such information, the said notice shall be regarded as null and void.

Penalties.
1884, 320, § 24.
1895, 501, § 5.
1896, 517, § 7.
143 Mass. 589.

SECTION 35. Whoever makes an appointment to office or selects a person for employment contrary to, or wilfully refuses or otherwise neglects to comply with, the provisions of this chapter or of any rule hereunder shall, unless some other penalty is specifically provided, be punished by a fine of not less than one hundred nor more than one thousand dollars for each offence.

Application of chapter.
1894, 267.
1896, 449.

SECTION 36. This chapter shall be in force in any town of more than twelve thousand inhabitants when accepted by it. So much of this chapter and the rules established under it as relate to the employment of laborers, designated as the "Labor Service," shall not be in force in any city of less than one hundred thousand inhabitants until the city council, with the approval of the mayor, accepts the same.

Application to fire and police forces in towns.
1901, 78.

SECTION 37. In a town which by a vote of a majority of the voters voting thereon at an annual or special town meeting accepts the provisions of this section or has accepted the corresponding provisions of earlier laws, the provisions of this chapter and the rules made under the authority thereof which relate to the police and fire forces of cities except Boston shall apply to all members of the regular or permanent police and fire forces, or to the call fire force, or to either of said forces, of a town. Such vote may limit the application of the provisions of this chapter and of the rules made thereunder either to the police force or to the fire force of such town, or it may extend such application to both of said forces. Upon such vote of acceptance, each member of the force or forces included therein and within the classified civil service shall continue to hold his office until his death, resignation or removal. He shall not be removed except for cause shown after a full hearing before the board or officer of the town having power to make removals, and such member shall have the right to be present at such hearing and to be represented by counsel.

THE CIVIL SERVICE RULES

OF THE

COMMONWEALTH OF MASSACHUSETTS AND THE CITIES THEREOF.

In accordance with the provisions of chapter 320 of the Acts of the year 1884, and acts in amendment thereof, the following rules have been prepared for the selection of persons to fill certain offices in the government of the Commonwealth and of cities and certain towns thereof, and for the selection of persons to be employed as laborers therein; and all rules heretofore prepared and approved are hereby rescinded.

RULE I.

Term "city" or "cities" defined.

The term "city" or "cities," as used in these rules, shall be construed to include and apply to every city or town in the Commonwealth to which such rules shall be applicable.

RULE II.

Appointments and removals, responsibility for.

The power to remove or reduce, within the classified service, existing by law, on the part of any officer or board, is not impaired by anything contained in these rules.

RULE III.

Regulations for carrying out rules.

The commissioners will make and issue, from time to time, as the needs of the service require, such regulations as may be necessary for conducting the business of their office, for the instruction of their secretary, chief examiner, registrar of labor and local boards of examiners, and for carrying out the provisions of these rules.

RULE IV.

1. For the purpose of making examinations of applicants, the commissioners will designate persons to be examiners, and may at any time substitute another person in place of any one so designated.

Commissioners to designate boards of examiners.

2. Whenever the special qualifications required for a position are such that assistance from experts in conducting an examination is advisable, such experts may be designated to aid the examining board; and, so far as practicable, such experts shall be persons employed in the department to which the applicant seeks admission.

Experts to aid examiners in certain cases.

RULE V.

In order that suitable provision may be made for conducting examinations in the several cities, the commissioners will, from time to time, apply to the proper authorities thereof for temporary quarters and for clerical assistance in receiving and filing applications for appointment in the local service.

Commissioners to apply to local authorities for temporary quarters, etc.

CLASSIFICATION OF THE SERVICE.

RULE VI.

The offices and places to be filled under these rules shall be classified in two divisions: the first to be known as "The Official Service" of the Commonwealth and the several cities thereof; the second as "The Labor Service."

Classification, two divisions.

FIRST DIVISION.

RULE VII.

1. There shall be two schedules under the first division, known as Schedule A and Schedule B.

First division, two schedules, A and B.

Schedule A.

2. Schedule A shall include clerks, copyists, recorders, bookkeepers, inspectors, agents, almoners, visitors, stenographers, typewriters, messengers, and persons rendering service similar to that of any of the above-specified positions, in the service of the Commonwealth or of any city thereof, under whatever

Amendments. Oct. 1, 1894, Feb. 15, 1897, and Feb. 1, 1900.

designation, whether such service is permanent or temporary, and whether the same is paid by time for work done, by the piece, or in any other manner.

There shall be the following classes in Schedule A: —

Class 1. Persons rendering service as clerks, copyists, recorders, book-keepers, or any similar service, whose annual compensation is at the rate of eight hundred dollars or less; also messengers, office boys over sixteen years of age, and all persons, under whatever designation, performing messenger or similar service, at said rate of compensation; *provided, however*, that the messengers of the governor, and one messenger of the mayor of any city, are excepted herefrom.

Class 2. Persons rendering similar service to that specified in class 1, whose annual compensation is at the rate of more than eight hundred dollars.

Class 3. Agents, almoners, inspectors other than inspectors of work, visitors, and all persons rendering similar service, under whatever designation, whose duties may be in part clerical.

Class 4. Stenographers and typewriters.

Schedule B.

There shall be the following classes in Schedule B: —

Amendment. Feb. 1, 1900.

Class 1. Turnkeys, watchmen, drivers of prison wagons, and all other persons doing police duty in the parks, public grounds, prisons, houses of detention, reformatories, and in all other public institutions, places and departments of the Commonwealth, and the several cities thereof, not included in classes 3 and 4 of Schedule B; also watchmen, gatemen and guards in the public parks and ferries.

Class 2. All members of the fire department in the city of Boston, except call substitutes.

Amendments. Oct. 1, 1894, and Feb. 1, 1900.

Class 3. *a.* The detective force of the district police.

b. The inspection force of the district police.

c. The regular and reserve police forces of, and all persons doing permanent police duty in and for and paid by, any city of the Commonwealth, except the city of Boston.

d. The special, substitute or supernumerary police force, and all persons doing temporary police duty in and for and paid by any city of the Commonwealth, except the city of Boston.

Class 4. All members of the regular and reserve police forces in the city of Boston.

Class 5. Engineers and assistant engineers, draw-tenders and assistant draw-tenders employed on bridges in the cities of the Commonwealth.

Classified March 1, 1886. Amended Oct. 1, 1894, and Feb. 1, 1900.

Class 6. Foremen of laborers, inspectors of work, and all persons, under whatever designation, doing similar work in the service of the Commonwealth, or any city thereof, and not included in Schedule A.

Class 7. Sub-foremen of laborers, and all persons, under whatever designation, doing similar work in the service of the Commonwealth, or any city thereof.

Class 8. Engineers, janitors and persons having charge of steam boilers and furnaces in the school buildings in the city of Boston.

Class 9. *a.* All members of the regular or permanent fire force of any city except Boston, after the proper authority of the city shall have requested the commissioners to include such force in the classified service.

b. All members of the fire force of any town by law within the classified service.

Class 10. All truant officers in the city of Boston. Nov. 1, 1893.

Class 11. Engineers, janitors and persons having charge of public school buildings heated by other means than direct furnace or stove heat in any city except Boston, after the school committee thereof shall have requested the commissioners to include such positions in the classified service.

Oct. 1, 1894, and May 1, 1895.

Class 12. Superintendents, assistant superintendents, deputies and persons, other than the chief superintendents of departments, performing any of the duties of a superintendent in the service of any city of the Commonwealth.

Feb 15, 1897.

Class 13. Civil engineers, surveyors, draughtsmen, transitmen, levellers, chainmen, rodmen, and all assistants, under whatever designation, except laborers, in the service of the Commonwealth, or any city thereof.

Feb. 15, 1897.

Class 14. The aids and other persons, under whatever designation, employed in detective service in the office of the State Fire Marshal.

Feb. 15, 1897.

QUALIFICATIONS.

RULE VIII.

State service, residence of applicants.

1. Applicants for appointment to any position in the service of the Commonwealth, to which these rules apply, must be citizens of the United States who have resided in the Commonwealth for one year next preceding the date of their applica-

tions. This restriction shall not apply to positions in which special expert knowledge is required.

City service, residence of applicants.

2. Applicants for appointment in the service of a city must be citizens of the United States, who have resided in the Commonwealth for one year and in the city in which they seek service for six months next preceding the date of their applications, except where special qualifications are required, and the appointing officer requests in writing that the examination be open to persons who are not citizens or residents.

RULE IX.

Disqualifications for appointment.

No application for appointment will be received from any vendor of intoxicating liquor, or any person habitually using intoxicating beverages to excess; or any person who, within the year preceding his application, has been convicted of any offence against the laws of this Commonwealth.

RULE X.

Moral character.

1. A good moral character is an essential qualification, and is of paramount importance in determining an applicant's right to admission to the eligible list.

Burden of proof.

2. The burden of proof of good character shall in all cases be upon the applicant, who may be required by the commissioners to furnish evidence thereof additional to the certificates required in his application.

Failure to prove good character.

3. Failure by the applicant to prove good character shall exclude him from examination and from the eligible list; and proof at any time produced to the commissioners of the bad character or dissolute habits of an applicant or eligible, of any criminal or disgraceful act committed by him, or his dismissal for good cause from the public service, shall be sufficient to exclude him from examination or to remove his name from the list of eligibles.

Applicant entitled to a hearing.

4. No person shall be so excluded from examination, and no one shall be removed from the eligible list, under this rule, except after an opportunity to be heard and upon a finding of the commissioners and a record thereof, containing the names of the commissioners voting therefor and a statement of the grounds of their action.

RULE XI.

1. In Schedule A the only requirement as to age, height and weight is that women must be not less than eighteen years of age at the time of filing the application.

Amendment as to age. Oct. 1, 1894.

2. In Schedule B there shall be the following requirements of age, height and weight: —

a. In class 1 applicants for appointment as metropolitan park police officers shall be not less than twenty-five and not over forty years of age at the time of filing the application, and must be not less than five feet seven inches in height and weigh not less than one hundred and thirty-five pounds.

Amendments. Oct. 1, 1894, and Feb. 1, 1900.

b. Applicants for appointment to the State Prison or Massachusetts Reformatory service must be not less than five feet seven inches in height and weigh not less than one hundred and thirty-five pounds.

Amendments. Oct. 1, 1894, and Feb. 1, 1900.

c. Other than as herein provided, there shall be in class 1 no requirement as to age, height or weight, and in no case shall the requirements apply to veterans.

Amendments. Oct. 1, 1894, and Feb. 1, 1900

d. In class 2 [the fire force of Boston] applicants for appointment must be not less than twenty-two nor over thirty years of age at the time of making application, and must be not less than five feet five inches in height and weigh not less than one hundred and thirty-five pounds; *provided, however*, that applicants for appointment in the call force of the fire department of Boston, who are serving as call substitutes in said department, may, for the purpose of making themselves eligible under the rules for examination, deduct from their actual age any time not exceeding five years during which they have served in such capacity; and *provided, further*, that applications for appointment to the force may be made by persons serving in the call force who are under forty years of age.

Amendments. Oct. 1, 1894, and Feb. 15, 1897.

e. In class 3 [the police force of any city other than Boston] applicants for appointment must be not less than twenty-two nor over forty years of age, and applicants for appointment to the district police force must be not less than "twenty-two nor over fifty-five years of age at the time of filing the application;" *provided, however*, that this limitation as to age shall not apply to veterans. In all cases in this class, except the inspection force of the district police, applicants must be not less than five feet seven inches in height and weigh not less than one hundred and thirty-five pounds.

Amendment. Feb. 1, 1888.

Amendment. Oct. 1, 1894.

Amendment. March 16, 1891.

f. In class 4 [the police force of Boston] applicants for appointment must be not less than twenty-five nor over thirty-three years of age at the time of filing the application, and must be not less than five feet eight inches in height and weigh not less than one hundred and forty pounds.

Amendment. March 1, 1893.

g. In class 9 [the fire force of cities other than Boston] applicants for appointment shall be not less than twenty-two nor over thirty-five years of age at the time of making application, and shall be not less than five feet four inches in height and weigh not less than one hundred and twenty pounds; *provided, however,* that call men serving in the fire department may deduct from their actual age any time not exceeding five years during which they have continuously served in such capacity.

Amendment. Nov. 1, 1893.

h. In class 10 [Boston truant officers] applicants for appointment shall be not less than thirty nor over forty-five years of age at the time of filing the application.

Amendment. Oct. 1, 1894.

i. In all cases under this rule applicants shall be measured in bare feet and shall be weighed without clothing.

j. Except as provided in this rule, there is no requirement as to age, height or weight; *provided, however*, an age limit may be recognized, if deemed expedient by the commissioners, except in case of a veteran.

APPLICATION.

RULE XII.

Applications, how made.

1. Applications for admission to examinations in the first division may be made at any time, and shall be on blanks in a form prescribed by the commissioners. Applications for appointment to positions in the service of the Commonwealth, and of the city of Boston, shall be filed in the office of the commissioners in Boston; applications for appointment to positions in the service of cities other than Boston shall be filed with the local board of examiners in the city where service is sought, or at such other place as the commissioners may designate.

Form of applications.

2. Each applicant for examination must state, under oath, and in his or her own handwriting: 1. Full name, residence and post-office address. 2. Citizenship. 3. Age. 4. Place of birth. 5. Health, and physical capacity for the public service. 6. Right of preference as a veteran. 7. Previous employment in the public service. 8. Business or employment, and residence, for the previous five years. 9. Education. 10. Such other information as may be required touching the applicant's fitness for the public service.

RULE XIII.

1. The word "veteran" in these rules shall mean a person who served in the army or navy of the United States in the time of the war of the rebellion, and was honorably discharged therefrom; and also a citizen of Massachusetts who has distinguished himself by gallant and heroic conduct while serving in the army or navy of the United States, and who has received a medal of honor from the President of the United States.

Definition of word "veteran." Amendment. Feb. 15, 1897.

2. Any veteran desiring appointment to office or employment in the service classified under the civil service rules, without having passed any examination provided for therein, shall file an application for such appointment, stating, under oath: (1) his full name, residence and post-office address; (2) the office he seeks; (3) that he desires appointment without having passed any examination provided for by the civil service act or the rules thereunder; (4) his service as a veteran; (5) that he has not suffered loss of limb, or other physical impairment, which incapacitates; (6) his citizenship; (7) that he does not habitually use intoxicating beverages to excess, and is not a vendor of intoxicating liquor; (8) that he has not within one year been convicted of any offence against the laws of the Commonwealth.

Veterans to file application. Amendment. Feb. 15, 1897.

3. Such application must be supported by certificates that the applicant has all the qualifications required by law of veterans. Such application, if for an office or employment in the service of the Commonwealth or of the city of Boston, shall be filed in the office of the commissioners in Boston; if for an office or employment in the service of any city other than Boston, it shall be filed with the examiners in such city.

Application to be supported by certificates.

RULE XIV.

Every application must be supported by certificates of good moral character, health, and physical and mental capacity for doing the public work, the certificates to be in such form and number as the commissioners shall prescribe. But no recommendation which may be given by any Senator, member of the House of Representatives, alderman or councilman, except as to the character or residence of the applicant, can be received or considered by any person concerned in making any appointment under these rules.

Applications must be supported by certificates.

Recommendations not received from certain legislators.

RULE XV.

Application for more than two classes. Amendment. Feb. 1, 1900.

No application from the same person will be received for appointment or employment in more than two classes of the civil service as herein classified; but this limitation shall not apply to veterans.

RULE XVI.

New application.

Any person possessing the required qualifications, who has taken an examination, may make a new application at any time after the result of such examination is determined; and if his name is upon the eligible list, it shall continue until the result of the examination is determined; and if he fails to pass the examination, his name shall be stricken from the eligible list; and if he passes such examination, he shall rank in accordance with the result.

RULE XVII.

Effect of false statements.

Every false statement knowingly made by any person in his application for examination, and every connivance by him at any false statement made in any certificate which may accompany his application, or any complicity by him in any fraud, shall be regarded as good cause for excluding him from the eligible list, or for his removal or discharge, after appointment.

RULE XVIII.

Defective applications returned.

Defective applications will be returned to applicants with a notice to amend the same. Whenever the application shows that the applicant is not qualified under the rules and regulations, the application will be rejected, and the applicant notified of the reason therefor.

RULE XIX.

Reception of applications and notice to applicants.

The date of the reception of each application shall be endorsed thereon, and the application recorded; and if the applicants for admission to any class are in excess of the number that can be examined at a single examination, they will be notified to appear in the order in which their applications are received; *provided, however*, that veterans shall have precedence in such notification.

EXAMINATION.

RULE XX.

1. All examinations shall be absolutely impartial, practical in their character, and with paramount regard to matters which will fairly test the relative capacity and fitness of the persons examined for the service which they seek to enter.

Examinations, character, notice of.

2. No question in any examination shall relate to political or religious opinions or affiliations, and no appointment or selection to an office, or for employment within the scope of these rules, shall be in any manner affected or influenced by such opinions or affiliations.

Political or religious opinions not to influence appointments.

3. The examinations shall be held at such times and places as the commissioners may designate, and proper notice thereof given. So far as practicable, the examination of applicants for appointment in the service of a city shall be held therein.

Time and place of examination.

RULE XXI.

1. The subjects of examination may be designated from time to time by the commissioners, and shall be such as the needs of the service require, and such as tend to prove the qualifications of the applicant for the office sought, and for this purpose the commissioners may subdivide any of the classes provided under the rules.

Subjects of examination designated. Amendment. Feb. 1, 1900.

2. Proficiency in any subject shall be credited in grading the standing of the person examined, in proportion to the value of a knowledge of such subject in the branch or part of the service which the applicant seeks to enter.

How graded.

3. No one shall be entitled to be certified for appointment whose standing upon a just grading in the examination shall be less than sixty-five percentum of proficiency in such of the subjects of the examination as may be designated by the commissioners.

Must obtain sixty-five per cent.

4. The commissioners may also order examinations upon other subjects of a technical or special character, to test the capacity which may be needed in any part of the classified service which requires peculiar information or skill. Examinations hereunder may be competitive or non-competitive. The application for, and notice of, the special examinations, the records thereof, and the certification of those found competent, shall be such as the commissioners may prescribe.

Examinations where special skill and experience are required.

RULE XXII.

Physical examinations.

1. Where physical qualifications are necessary, the commissioners will provide for examinations to determine them.

By whom made. Amendment. Oct. 1, 1894.

2. The examinations to test the physical soundness of applicants for positions in the classified service shall be made by the medical examiners, if for the Commonwealth service, and by the city physicians, or their assistants, if for city service, and by the town physician, if for town service, unless the commissioners shall appoint a physician to conduct such examinations. The results of such examinations shall be certified on blanks furnished by the commissioners.

Additional physical examination.

3. Each applicant in any of said classes may be required to undergo such further physical examination as the commissioners may prescribe, adapted to ascertain his special fitness for the service for which he has applied. Any such examination shall be made by a suitable examiner, to be designated by the commissioners, and the result shall be recorded upon blanks provided for the purpose.

ELIGIBLE LIST.

RULE XXIII.

When examined, applicants shall be graded.

1. Those examined shall be marked and graded, and shall have their grade entered upon a register. Separate registers may be kept of those seeking to enter any part of the service in which special qualifications are required.

Veterans eligible without examination. Amendment. Feb. 15, 1897.

2. Every veteran applying for appointment without examination, who shall have furnished satisfactory evidence that he possesses the qualifications claimed in his application, shall have his name entered upon an eligible list without examination.

Eligible two years.

3. No person shall remain eligible more than two years upon any eligible list.

Amendment. Feb. 1, 1900.

4. When a person has been regularly certified and appointed under the rules, and then suspended from employment, he may at any time within one year of such suspension, if within two years of the time his name was placed upon the eligible list, have his name restored to such list, to the same effect as though not certified.

RULE XXIV.

Persons examined may have a certificate.

The commissioners may give to any person examined a certificate of his or her marking.

REQUISITION AND CERTIFICATION.

RULE XXV.

Requisition.

Whenever there is a vacancy to be filled in the classified service, the appointing officer shall make requisition upon the commissioners for the names of eligible persons. The term "appointing officer" in these rules shall mean and include any and all persons and boards having the power of appointment.

RULE XXVI.

Certification of eligible persons. Amendment. Feb 15, 1897.

1. Whenever any appointing officer shall make requisition, not expressly calling for women, the commissioners shall certify only the names of all veterans who have passed the examination for the position sought, in the order of the respective standing of such veterans upon the eligible list, and the position must be filled by the appointment and employment of some veteran so certified, before the names of persons not veterans can be certified; and in case there is no such veteran upon the list, then the commissioners shall certify the names of the three most eligible persons not veterans upon the list. In case such officer shall in the requisition request the certification of women, the commissioners shall certify the names of the three women most eligible.

Appointment.

2. The appointment and employment shall be made from the list of names so certified, subject to the provisions of the following section: —

Certification of veterans.

3. Whenever any appointing officer shall in the requisition so request, the names of any or all veterans registered shall be certified, and any of the veterans so certified may be appointed and employed in the office or position sought.

RULE XXVII.

Certification of specialists. Amendment. Feb. 1, 1900.

Whenever the commissioners are notified that proficiency in any special subject is needed in the position to be filled, they may certify the names of three persons on the eligible list having the highest standing (not being below the minimum of sixty-five) in such special subject, or they may certify from any list of eligibles in any class, if by them deemed suitable.

Rule XXVIII.

No person to be certified more than three times, except, etc.

1. No person on any register shall be certified more than three times for the same office, except upon the request in writing of the appointing officer; *provided, however*, if the office requires special or expert qualifications, persons may, in the discretion of the commissioners, be certified more than three times.

Certification, method of.

2. In any requisition to fill one vacancy, three names shall be certified. In case the appointing officer shall make requisition to fill more than one vacancy, the number of eligibles therefor shall be certified as follows: for two vacancies, four names; for three vacancies, five names; then for each multiple of three vacancies, the same multiple of five names; for one vacancy over a multiple of three, three names additional to those prescribed for such multiple; for two vacancies over a multiple of three, four names in addition to those prescribed for such multiple; *provided, however*, veterans shall be certified as hereinbefore provided.

3. When certification of three names is made to fill one vacancy, each of the three persons so certified shall be charged with one certification. When certification of four names is made to fill two vacancies, each of the persons so certified shall be charged with two certifications. When certification is made to fill three or more vacancies, each of the persons so certified shall be charged with three certifications.

4. Whenever an appointing officer, who shall have made a requisition to fill a certain number of vacancies, shall appoint a smaller number than that of the vacancies named by him, he shall not make the selection from the whole number certified to him, but only from that number of names standing highest upon said list that would have been certified to him had the requisition stated the number of vacancies which he actually filled.

Rule XXIX.

Sex.

In case any law, regulation, or requisition shall call for persons of one sex, those of that sex shall be certified; otherwise, sex shall be disregarded in certification.

Rule XXX.

Certification of additional names.

Upon proof satisfactory to the commissioners of the advisability of so doing, they may certify an additional name; but in every such case the reason for so doing shall be stated in such certification.

APPOINTMENT.

RULE XXXI.

No person shall be appointed in the classified service in the first division except in the manner provided in these rules. **Appointment.**

RULE XXXII.

No person serving temporarily, or as a substitute, special or supernumerary official, under whatever designation, in any position in the classified service, shall be appointed to any permanent position without requisition and due certification; *provided, however*, that, where a reserve police force has been established by law in any city, any member thereof may be appointed to the regular police force of such city without examination or certification, if he shall have served at least six months upon the reserve police force. **Substitutes, specials and supernumeraries. Amendment. Feb. 1, 1900.**

RULE XXXIII.

1. In the selection from the persons whose names are certified by the commissioners, the appointing officer, upon written requisition therefor, will be furnished with the applications, the certificates and examination papers of the persons certified; and, in the exercise of his responsible power of selection, he may summon personally before him the certified persons for such inquiries as he may deem proper. All papers furnished upon requisition as above must be returned to the commissioners with the notice of selection. **Appointing officer to be furnished with examination papers, etc.**

2. The appointing officer, if the vacancy is filled, must appoint and employ a person from the list certified under these rules. **Appointment.**

3. No person shall be regarded as appointed within the requirement of these rules, unless he is notified of his appointment, and, if he accepts the position, is actually employed.

RULE XXXIV.

In cases where there is no suitable eligible list and the commissioners are unable to comply with the requisition, they may, in their discretion, allow a provisional appointment, which **Provisional appointment. Amendment. Oct. 1, 1894.**

may continue until a list of eligibles is obtained by examination, or they may authorize the appointing officer to select a suitable person, who shall be subjected to a non-competitive examination, and, if found qualified, shall be certified for appointment; *provided, however*, that, whenever practicable, a competitive examination of applicants for the office shall be held.

Rule XXXV.

Original appointments shall be for a probationary period.

Every original appointment and employment in the permanent service in the first division shall be for the probationary period of six months; at the end of which time, if the conduct and capacity of the person appointed have been found satisfactory to the appointing officer, the probationer shall be absolutely appointed or employed, but otherwise be deemed out of the service.

Rule XXXVI.

Commissioners to be notified of person selected, etc.

Every officer having the power of appointment to any position in the first division shall, within ten days, give notice in writing to the commissioners of the name and place of residence of any person appointed and employed in such position, of the rejection of any such person during or after-probation, and of the transfer, promotion, resignation or removal, discharge or death, of any person serving under him, with the dates thereof.

Reappointment.

Rule XXXVII.

Reappointment, no examination for. Amendment. Feb. 15, 1897.

1. No examination shall be required upon a reappointment of any person to the same office immediately upon the expiration of his term of office.

Reinstatement of persons dismissed. Amendment. Feb. 15, 1897.

2. Any person appointed to and employed in any position in the first division of the classified service, who shall be found or certified to the commissioners by the proper authorities to have been dismissed or separated therefrom without fault or delinquency on his part, may be reinstated without further examination, in the same part or grade of such service, within six months next following such dismissal or separation.

TEMPORARY SERVICE.

RULE XXXVIII.

1. Appointments in the first division for temporary service shall be made in accordance with the civil service rules, except in case of emergency, where the public business would suffer from delay in filling the position as herein provided. In no case shall such appointment or employment for an emergency continue for more than ten days, and no reappointment or employment of the same person, or of another to the same position at the end of such period, shall be allowed. In every such case the officer making the appointment, or furnishing the employment, shall report the same to the commissioners within five days, with the reason therefor and the time for which the temporary appointment or employment is necessary. **No person shall be appointed for temporary service, unless regularly certified, except, etc. Amendment. Oct. 1, 1894.**

2. If for any sufficient reason it shall be impracticable to certify the names of persons who have passed a competitive examination in due season for any appointment or employment in any position in the first division, the commissioners may provide for a provisional appointment by non-competitive examination or otherwise. **Provisional appointments in certain cases.**

TRANSFER.

RULE XXXIX.

1. Transfer within the classified service without examination may be made from a position in one department, office or institution, to a similar position in another department, office or institution, upon the consent in writing of the heads of the respective departments, offices or institutions; *provided, however*, that no person shall be transferred from classes 3 or 4 of Schedule A, who has never passed an examination under the rules, which entitles him to be placed on an eligible list for the position to which he desires transfer. **Transfer without examination.**

2. Police officers of a city may be furnished to serve the authorities of any other place, as provided by statute, without requisition upon, or notice to, the commissioners.

3. A person in one class of the first division may be transferred upon non-competitive examination to a position in any other class, provided such person shall have served at least one year in the former position, including any time of probationary service. **Amendment. Feb. 1, 1900.**

PROMOTION.

RULE XL.

Amendment. Oct. 1, 1894.

1. Promotions, within the several schedules and classes of the first division of the classified service, except as hereinafter provided, shall, so far as practicable, be made by successive grades, and may be by competitive or non-competitive examination; *provided, however*, that no person shall be promoted who has not passed such examination as may be required by the commissioners, and has not served at least one year in the lower position.

2. Promotions in class 2 of Schedule B may be by competitive or non-competitive examination; *provided, however*, that promotions from the call to the permanent force shall be made only through competition with all applicants for said force, except as provided in chapter 256 of the Acts of 1896.

3. Promotions in class 3 of Schedule B shall, so far as practicable, be by successive grades and by competitive or non-competitive examination, as the commissioners may determine; *provided, however*, that no special, supernumerary, substitute, reserve, or temporary police officer, under whatever designation (unless a permanent reserve force in any city is established by act of the Legislature), shall be promoted to the regular or permanent force, or assigned to permanent duty, except after competition with all applicants for said force.

4. Promotions in class 4, Schedule B, shall, so far as practicable, be by successive grades and through competitive or non-competitive examination.

5. Promotions in classes 5 and 6, Schedule B, may be made through non-competitive examination.

6. Promotions in class 8 of Schedule B may be made without examination; *provided, however*, that no person shall be promoted or transferred from a position in a furnace-heated school to a steam-heated school without having passed a suitable examination in the care and handling of steam.

Veterans preferred in promotion. Amendment. Sept. 1, 1900.

7. In all cases of promotion under this rule, any veteran in the grade from which the promotion is to be made shall be entitled to apply for examination, and upon passing the examination shall be preferred in such promotion, and any unexamined veteran may be appointed to the position.

OFFICES NOT INCLUDED IN RULES.

RULE XLI.

Applicants for offices not covered by rules may be examined.

Upon the request of any officer or board having the power of appointment to any office or position in the service of the Commonwealth, or any of the cities thereof, to which these rules do not apply, the commissioners will furnish names from any list of eligible persons to fill a vacancy in such office or position; or they will, whenever practicable, hold competitive or non-competitive examinations for such office or position.

SECOND DIVISION.

LABOR SERVICE.

The following rules relating to the labor service are established under authority of chapter 320 of the Acts of the Legislature of 1884, and also of section 6 of chapter 517 of the Acts of 1896, and in enforcement of said acts.

RULE XLII.

Amendment. Feb. 1, 1900. Laborer, term defined.

1. The word "laborer" in these rules shall be construed to include mechanics, engineers, janitors other than those classified in the first division, laborers, whether skilled or unskilled, under whatever designation, and boys employed in the labor service of any city.

Classification.

2. The labor service shall constitute the second division of the civil service. Under it there shall be two schedules, Schedule C and Schedule D. Schedule C shall include all laborers as herein defined, in the employ of the city of Boston, to be designated as the labor service of Boston. Schedule D shall include all laborers as herein defined in the employ of any city other than Boston to which these rules are or may become applicable, to be designated as the labor service of such city.

Registration.

3. The commissioners shall provide for the registration and certification of laborers in the city of Boston, and in other cities to which the labor rules are or may become applicable.

4. In Schedule D the commissioners may, in their discretion, discontinue registration and certification whenever a city shall

fail to appropriate such sum of money as, in their opinion, is necessary to provide for the full enforcement of all rules and regulations relating to the labor service of such city. Notice of their action in each case shall be certified to the authorities of such city and shall be published in one or more newspapers therein.

LABOR APPLICATION.

RULE XLIII.

Where registered.

1. Laborers shall apply for registration at the civil service labor office in the city where they seek employment.

Must be citizens.

2. Applicants must be citizens of the United States, who have resided in the Commonwealth for one year and in the city in which they seek employment for the six months next preceding the date of the application, except in special cases, where the commissioners are unable to obtain a sufficient number of citizens and residents to meet the demands of the departments.

Vender of liquor cannot apply.

3. No application will be received from a vender of intoxicating liquor, or from any person habitually using intoxicating beverages to excess, or any person who within the year preceding his application has been convicted of any offence against the laws of this Commonwealth.

Application supported by certificates.

4. Every application must be supported by certificates of good character, and any false statement knowingly made by any applicant for labor service, or any connivance at any false statement made in any certificate accompanying his application, or any complicity in any fraud, shall be good cause for removing his name from the register, or for his discharge after employment. No applicant shall remain eligible more than one year from the date of his registration, except upon personal application for a renewal. The commissioners, for due cause, may reject any application for such renewal.

Laborers, how registered. Amendment. Feb. 15, 1897.

5. Every applicant who produces satisfactory evidence of his capacity for labor and his habits as to industry and sobriety, shall be registered in the order of his application. He shall state under oath his (1) name, (2) age, (3) residence, (4) citizenship, (5) the number and relationship of persons depending upon him for support, (6) service as a veteran, (7) previous occupation, (8) personal description, and such other information as may be required.

Applicants shall file certificates. Amendment. Feb. 15, 1897.

6. Every applicant shall file a certificate, signed by two reputable citizens, to the effect that he is qualified to perform the labor sought. Every applicant claiming preference as a veteran shall also produce satisfactory evidence of the fact.

7. When the applicant desires to be registered for any other service than that of common laborer, he will be required to furnish a certificate from some competent person or persons of his ability to do the kind of work for which he alleges capacity, and for which he desires to be certified, and he may file additional certificates of capacity for special service.

8. In case any applicant shall present any certificate in regard to his qualifications in previous work inconsistent with his application or previous certificates, the commissioners may refuse to register him, or may remove his name, if registered, from the list.

Certificate from appointing officer. Amendment. Feb. 15, 1897.

9. No certificate from an employing officer in regard to the capacity of a laborer applying for registration shall be received, unless the laborer has been legally employed in the department, and the employing officer has an official knowledge of his capacity.

Removal from register.

10. In case any applicant is found by the commissioners to be unfit or in any way disqualified to perform the service which he seeks, his name shall not be entered on the register, and, if on the register, shall be removed therefrom, and the reason shall be endorsed on the application.

May require examinations. Amendment. Feb. 15, 1897.

11. The commissioners may in their discretion provide and require examination regarding the qualifications of any applicant.

LABOR REQUISITION AND CERTIFICATION.

RULE XLIV.

Requisition and certification. Amendment. Feb. 15, 1897.

1. When laborers are required, the employing officer shall make requisition upon the commissioners, stating the number of men wanted, the precise nature of the labor in which they are to be employed and the time and place of employment. Upon such notice, the commissioners shall certify the names of any and all veterans upon the eligible list, and the employment must be made from the list so certified; *provided* that, after the employment of veterans, in case there is not a sufficient number of veterans so registered and qualified for the required labor,

the commissioners shall certify twice the number of men called for, over and above the number of veterans, if any, certified, making an impartial selection, giving preference, *first*, to those who have worked satisfactorily for three months or more in the department, and, *second*, to those having families dependent upon them for support.

Requisition for young men. Amendment. Feb. 15, 1897.

2. In case the employing officer shall in the requisition certify that the labor to be performed is so arduous as to require the services of young and vigorous men, and shall designate a maximum age limit, the commissioners may in their discretion recognize such age limit.

When unable to fill requisition.

3. Whenever the commissioners shall be unable to fill a requisition, they may authorize the employing officer to make the selection. The persons so selected shall, before being employed, present themselves at the civil service labor office, in their city, for registration in the manner and under the rules and regulations prescribed for applicants, and be certified by the commissioners, and such persons shall not be employed at any other kind of work than that for which they were selected, until after they shall have been continuously so employed for at least three months.

Labor Employment.

Rule XLV.

Employment from list certified.

1. The selection and employment shall be made from the list certified, and the employing officer shall, before selecting or employing any other person, first employ from the list of veterans certified, and the names of those employed shall be returned to the commissioners within five days after such employment.

Certification of veterans.

2. Whenever the employing officer shall request the certification of any or all veterans registered for any particular kind of work, they shall be certified, and any of the veterans so certified may be employed.

Method of selection.

3. Whenever an employing officer, who shall have made a requisition for a certain number of laborers, shall employ a smaller number, he shall not make the selection from the whole list certified to him, but only from that number of names standing highest on the list that would have been certified to him had the requisition stated the number of men which he

actually employs under the certification, except in the case of the certification of veterans, when he may employ any veteran certified.

Certification of additional names.

4. Upon proof to the commissioners that a person certified as a laborer is unsuitable for the work, the commissioners may certify an additional name.

Return of persons employed.

5. When the employing officer has selected and employed such of the persons named in said list as he may require, he shall within five days after their employment return to the commissioners' office a list of the persons so selected and employed, stating the kind of work for which they have been employed. In case any of the persons certified fail to respond or decline the employment offered, or withdraw from the service without good cause, the names and registered numbers of such persons shall be returned to the commissioners, with a statement of the facts; and the names of such persons shall be taken from the register, unless a satisfactory explanation of the failure or refusal to work is given.

EMERGENCY.

RULE XLVI.

Selection in cases of emergency. Amendment. Feb. 15, 1897.

In cases of emergency which cannot be foreseen, where the department would suffer from delay in filling a vacancy in the labor service, as herein provided, the employing officer may temporarily employ persons, without requisition; *provided, however*, that in no case shall such temporary employment continue for more than five days, and no re-employment of the same person at the end of such period shall be allowed. And in every such case the officer shall report the employment to the commissioners within five days, with the reason therefor.

SUSPENSION AND TRANSFER.

RULE XLVII.

Suspension for six months. Amendment. Feb. 15, 1897.

1. Any laborer suspended and not actually employed in the department in which he is enrolled shall at the end of six months be deemed to be out of the service, and shall not be thereafter employed, except after registration and certification by the commissioners; and the employing officer shall forthwith report to the commissioners the name of any laborer so suspended;

provided, however, that this provision shall not apply to veterans.

Not to be employed in work other than that for which certified. Amendments. Feb. 15, 1897, and Feb. 1, 1900.

2. No laborer shall be employed in work other than that for which he is certified until after actual and continuous employment therein for at least three months; *provided, however*, that this provision shall not apply to veterans.

3. Heads of departments may, with the consent of the commissioners, transfer laborers from one department to another, upon previous notice to the commissioners, provided such laborers have been continuously employed in the same work in the same department for which they were certified for at least three months.

REINSTATEMENT.

RULE XLVIII.

Reinstatement. Amendment. Feb. 15, 1897.

Any laborer who shall be found by the commissioners to have been dismissed or separated from the service without fault or delinquency on his part may, upon request of the employing officer, be reinstated in such service in the same department within three months next following such dismissal or separation.

LABOR DISCHARGE.

RULE XLIX.

Discharges.

1. When a person is discharged from the labor service for "loitering," "incompetence," "insubordination," "unsatisfactory work," or any equivalent cause, unless the charge is disproved, he shall not be eligible for registration again for a period of at least six months from the date of such discharge. At the end of that time he can apply for registration on the same basis as other citizens; and, in case he is registered, he shall not be eligible to certification to the department from which he was discharged except with the written consent of the head of that department.

2. When a person is discharged from said service for "intoxication," and the charge is not disproved, he shall not be eligible for registration again for a period of at least a year from the date of such discharge; and his registration then will be subject to the conditions above prescribed.

3. In case a person is discharged a second time for good cause he shall not be eligible for registration again, except by special vote of the commissioners.

The foregoing rules, prepared by the Civil Service Commissioners, are hereby transmitted to the Governor and Council for their approval.

CHAS. THEO. RUSSELL,
CHAS. H. PORTER,
WINTHROP L. MARVIN,
Civil Service Commissioners.

DECEMBER, 1901.

Approved in Council, Dec. 24, 1901.

E. F. HAMLIN,
Executive Secretary.

A true copy.

Attest: WARREN P. DUDLEY,
Secretary of Civil Service Commissioners.

Due notice has been given that the foregoing Civil Service Rules will go into operation on the first day of March, A.D. 1902.

REGULATIONS

ADOPTED BY THE

CIVIL SERVICE COMMISSIONERS.

[Dec. 27, 1901.]

Chief Examiner.

1. The chief examiner shall, so far as practicable, attend the examinations held by the several boards of examiners.

2. He shall take care to secure accuracy, uniformity and justice in the proceedings of all examiners and boards of examiners under the rules and regulations; and such proceedings and all papers appertaining thereto shall at all times be open to him. He shall also, from time to time, inspect the proceedings and papers connected with examinations under the civil service rules, and shall make report of such inspection to the commissioners.

3. He shall prepare and submit to the commissioners proper schemes for examinations, and forms for blanks and records.

4. He shall take care that the rules and regulations are complied with, and shall bring any case of their infraction, or of injustice or irregularity, observed by him, to the attention of the commissioners. It shall be his duty, from time to time, to confer with the heads of departments, offices and institutions of the Commonwealth, and the several cities thereof, concerning the regularity, sufficiency and convenience of the examinations for the service under them. He shall perform such other appropriate duties as may be specified in these regulations, or otherwise assigned to him by the commissioners.

Secretary.

5. The secretary shall keep the records of the proceedings of the commissioners, and have charge of, and be responsible for, the safe keeping of the books, records, papers and other property in their office. He shall make such certification as the commissioners may direct of those eligible for appointment or employ-

ment. He shall generally conduct the correspondence of the commissioners, and perform such other appropriate duties as they may assign to him.

REGISTRAR OF LABOR.

6. The registrar of labor shall keep the records of his office and be responsible for the safe keeping of records, books, papers and other property in the labor office; he shall make proper certifications of those eligible for employment in the labor service, and he shall generally superintend the work of the office and supervise the administration of the civil service rules applicable to the classified labor service.

EXAMINERS.

7. Regular boards of examiners shall consist of not less than three nor more than five members, one of whom shall act as secretary; and a majority of any board may conduct an examination in the absence of the other members.

8. The board of examiners for each city shall promptly notify the commissioners of the need of holding an examination in and for such city; and thereupon the chief examiner shall, under the direction of the commissioners, issue authority therefor, and shall prepare questions and supervise the other preliminary arrangements.

9. The boards of examiners shall conduct the examinations, and estimate and mark the standing of the persons examined, or in a non-competitive examination shall mark the qualifications of the person examined.

10. Special boards will be selected, and special regulations for examinations will be issued by the commissioners when expedient.

11. No examiner or person serving under the commissioners shall attempt to influence the selection of any person for the civil service.

12. The examiners shall preserve order and decorum at examinations, and prevent any interference, by conversation or otherwise, with those under examination.

13. Each examiner will exercise diligence in securing fairness and preventing collusion and fraud in the examinations.

14. No examiner shall disclose, unless by consent of those examined, the results of the examination.

15. Any person, after receiving official notification of his standing, as ascertained by a competitive examination, may, in person or by duly authorized agent, inspect his examination papers.

16. Complaints of any injustice or unfairness on the part of

any examiner or examining board, or by any one acting under the commissioners, may be made in writing to the commissioners, who will act as substantial justice in the premises may require.

17. Each examiner shall be entitled to receive from the appropriation for the expenses of administering the civil service law twenty cents for each applicant whose examination he shall attend, and twenty cents additional for each set of examination papers he shall mark; the total number of papers prepared by one applicant being considered a set. For the additional service rendered by the secretary of each board of examiners of cities other than Boston, in registering the eligibles, certifying the same, conducting necessary correspondence, and in other ways, he shall be entitled to receive from the same appropriation the additional sum of twenty-five cents for each eligible so registered. [3, 24, '93.]

18. No person shall act as examiner in any examination of applicants for admission to the classified civil service, when he is an applicant or an eligible for a position in the class for which the examination is being held. [12, 21, '94.]

Competitive Examinations.

19. Applicants must present themselves punctually at the times and places specified in their official notices to attend, and they will be admitted to examination upon the production of such notices.

20. Each applicant in a competitive examination shall first be presented with a declaration paper, on which he will write his name, age, residence, examination number, etc., after which he will place it in an envelope, seal the envelope, and thereafter he shall mark each paper with his examination number only. The envelope shall not be opened until after all his examination papers are marked.

21. The sheets of questions will be numbered, and will be given out in the order of their numbers, each after the first being given only when the competitor has returned to the examiners the last sheet given to him. In general, no examination shall extend beyond five hours. Each applicant must complete his examination on the obligatory subjects before taking up any of the optional subjects.

22. The subjects of, and the time allowed for, the examination, will be announced before the first paper is given out.

23. Applicants for appointment in classes 2 and 4, Schedule B (the fire and police departments of the city of Boston), shall be examined to test their physical soundness, and no one who fails to pass such examination shall be eligible for appointment.

24. Each applicant who shall have passed such examination, and also the educational examination, shall be required to undergo

such further physical examination as the commissioners may from time to time prescribe, adapted to ascertain his special fitness for the service for which he has applied.

25. Such examination shall be made by a physical examiner, to be appointed by the commissioners, and shall be recorded upon blanks provided for the purpose, upon which each required qualification shall be entered, and shall be marked with the percentage of excellence which the several applicants shall respectively be found to possess.

26. The percentage of each qualification shall be multiplied by the weight prescribed for each by the commissioners; and the quotient found by the division of the aggregate of value so arrived at, of each applicant, by the aggregate of weights shall constitute the percentage of condition of such applicant.

27. When an applicant for police or fire service in Boston fails to obtain sixty-five per cent. in either strength tests or development, he shall not be re-examined in those subjects until after he has filed a new application and undergone another examination as a new applicant. [1, 9, '91.]

28. To determine the standing of applicants for appointment in Class 4, Schedule B (the police force of Boston), equal weight shall be given to the physical and educational examinations; in Class 2, Schedule B (the fire force of Boston), the comparative weight to be given to each of such examinations shall be three to two. [1, 30, '94.]

29. Applicants for fire service in Boston, who have passed the examination and are on the eligible list for appointment to the permanent substitute force, may be certified for appointment to the call force upon the percentage obtained in their educational examination: *provided*, *however*, that such certification, or appointment in the call force, shall not affect their standing on the eligible list for the permanent substitute force.

30. Applicants for positions as watchmen and turnkeys in the State Prison and Massachusetts Reformatory shall undergo such physical examination as the commissioners may prescribe.

NON-COMPETITIVE EXAMINATIONS.

31. In cases where a non-competitive examination may be needed, either to test the capacity of applicants for any part of the service which requires peculiar information or skill, or to fill a position for which there are no suitable candidates on the eligible list, or for promotion, or temporary appointment, or otherwise, the commissioners will provide for such examination.

32. Applicants for non-competitive examinations shall fill out and make oath to the proper application paper (without certifi-

cates); but any person named by the appointing power for non-competitive examination may file such paper at any time before undergoing the examination.

33. The non-competitive examination shall conform, as nearly as practicable, in subject, questions and marking, to the competitive examination of the same grade.

34. Non-competitive examinations shall, in the absence of any special regulations to the contrary, be conducted by the chief examiner, and the papers marked by him with the assistance of such person as he may select.

SPECIAL EXAMINATIONS.

35. Applications for any special examination must be made in the form prescribed by the commissioners, and must be accompanied by certificates, as required in cases of ordinary applications.

36. Whenever a special examination is to be held, proper notice shall be given by advertisement or otherwise.

37. Each special examination shall embrace the subjects approved by the commissioners, after consultation with the head of the office concerned, or the special examining board for such office; and shall, so far as appropriate, be conducted under the general regulations, as to the marking of examination papers and the grading of persons examined.

38. A special record of applicants, and a special register of eligible persons, shall be kept for each part of the service, or office requiring special examinations; and when the commissioners or the proper examining board shall be notified by the appointing officer of a vacancy in such part of the service, certification shall be made to him of the names of the three persons graded highest on the special list of persons eligible for the same.

39. In case competent special applicants do not apply, after suitable notice, the appointing officer may be authorized to select a person for non-competitive examination.

MARKING.

40. Each examination paper shall be reviewed by a majority of the examiners conducting the examination; and, in any case of disagreement, the average of the markings made on any question or paper by all shall be the final marking on such question or paper.

41. The papers in each subject shall, whenever practicable, be examined, compared and marked before the papers in another subject are examined.

42. The marking of each question or subject shall be made on a scale of 100, which shall represent entire accuracy. Handwriting will be judged by its legibility, uniform and correct formation of letters and ease of execution. Upon a comparison of the handwriting of all, the best and worst should be first determined, and the two extremes of the scale thus fixed; the others should be marked relatively to them. In writing from dictation or copying from manuscript, the omission, repetition or substitution of words, the erasures, blots and other evidences of carelessness, will reduce the marking below 100. Abstracts or summaries of documents, and letter-writing, will be marked as in handwriting, by determining the best and worst examples; and the examiners, having marked these, will then mark the others proportionately.

43. In each of the other subjects, each question shall be marked on a scale of 100; and the sum of such markings, divided by the number of questions in that subject, shall determine the standing on such subject.

44. In marking the examination papers of applicants for police, prison and fire service, orthography shall not be marked as a subject to which a special weight is attached; but errors in orthography shall be taken into account in marking the exercises in copying, letter-writing and reporting.

45. The following examples show the method by which the standing of each competitor is obtained. The weights here given to the different subjects are not to be regarded as the standard weights; these, and also the subjects, will be varied to meet the requirements of the position to be filled.

EXAMINATION OF ____________________

(For a position in Class 1, Schedule A.)

SUBJECTS.	Standing on Subjects.	Weight given to Subjects.	Product of Weight and Standing.
Penmanship, ...	80	4	320
Dictation, ...	75	2	150
Copying rough draft, ...	70	3	210
Orthography, ...	85	1	85
Arithmetic, ...	82	3	246
Composition, ...	70	2	140
	-	15	1,151
General average standing, . . .	-	-	76.73

EXAMINATION OF________________________

(For a position in Class 2, Schedule A.)

SUBJECTS.	Standing on Subjects.	Weight given to Subjects.	Product of Weight and Standing.
Penmanship, ...	85	4	340
Dictation, ...	90	2	180
Copying rough draft, ...	96	3	288
Orthography, ...	100	1	100
Arithmetic, ...	80	3	240
Interest and discount, ...	75	2	150
	-	15	1,298
General average standing, . . .	-	-	86.53

EXAMINATION OF________________________

(For a position in Schedule B.)

SUBJECTS.	Standing on Subjects.	Weight given to Subjects.	Product of Weight and Standing.
Penmanship, ...	70	2	140
Copying, ...	80	2	160
Clearness and correctness of statement, .	75	3	225
Experience, ...	80	3	240
Arithmetic, ...	70	2	140
Local data; duties, ...	70	3	210
	-	15	1,115
Educational qualifications, ...	-	-	74.33
Physical qualifications, ...	-	-	85.
	-	2	159.33
General average standing, . . .	-	-	79.66

It will be observed that the standing on each subject is multiplied by the weight given that subject, and the product placed in the third column; the sum of these products, divided by the sum of the weights, gives the general average standing.

ELIGIBLE LIST.

46. The names of those found eligible shall be enrolled upon a register in form prescribed by the commissioners.

47. Priority of date in examination will give no advantage in position on the eligible list.

48. The names of persons placed on the eligible list in Class 2 of Schedule A (the higher clerical service) may also, upon request in writing, be placed on the eligible list for positions in Class 1 of Schedule A, with the same standing.

49. Persons whose names are on the eligible list for the prison service of a city may, upon request in writing, have their examination papers marked by the State Board of Examiners; and, if they are found qualified, their names may be placed on the eligible list for the prison service of the Commonwealth. Persons whose names are on the eligible list for the prison service of the Commonwealth, who have been residents of the city in which they reside for six months, may, upon request in writing, have their examination papers marked by the board of examiners for the city in which they reside; and, if they are found qualified, their names may be placed on the eligible list for the prison service of said city.

CERTIFICATION.

50. Certification of eligibles under the rules shall be as follows: —

For	1	vacancy	certify	3 names.	For	11	vacancies	certify	19 names.
	2	vacancies	“	4 “		12	“	“	20 “
	3	“	“	5 “		13	“	“	23 “
	4	“	“	8 “		14	“	“	24 “
	5	“	“	9 “		15	“	“	25 “
	6	“	“	10 “		16	“	“	28 “
	7	“	“	13 “		17	“	“	29 “
	8	“	“	14 “		18	“	“	30 “
	9	“	“	15 “		19	“	“	33 “
	10	“	“	18 “		20	“	“	34 “

GENERAL PROVISIONS.

51. In case a person upon any register shall, by reason of ill-health or physical incapacity, in the judgment of the commissioners, become manifestly disqualified for the service for which he or she is registered, the commissioners may direct that such person be not certified; and the commissioners must be informed by the proper examining boards of each case of such disqualification.

52. The applicant affected by such suspension, or refusal of an examination, may make complaint in writing to the commissioners, who will take proper action thereon.

53. The commissioners cannot advise persons as to vacancies in the service, nor furnish any information as to the duties, salaries, course of promotion, or other conditions of positions and offices, except such as may be found in printed regulations. No advice can be given as to the course of preparation that applicants should follow, nor can specimens of the examination papers be furnished.

54. Every application paper and accompanying certificates will remain on file in the office of the commissioners or boards of examiners, and under no circumstances or conditions will the originals be returned to the applicant.

CIVIL SERVICE COMMISSIONERS.

CHARLES THEODORE RUSSELL, *Chairman*, CAMBRIDGE.
CHARLES H. PORTER, QUINCY.
WINTHROP L. MARVIN, BOSTON.

Chief Examiner.

HENRY SHERWIN, JAMAICA PLAIN.

Secretary.

WARREN P. DUDLEY, BELMONT.

Office of Civil Service Commissioners, Rooms 151, 152, State House, Boston.

Registrar of Labor, — Labor Office, State House, Boston.

WILLIAM L. HICKS.

Registration Clerk, — Labor Office, City Hall, Cambridge.

HARRY L. LINCOLN.

Registration Clerk, — Labor Office, Library Building, New Bedford.

GEORGE P. BROCK.

Registration Clerk, — Labor Office, City Hall, Newton.

THEODORE A. FLEU.

Registration Clerk, — Labor Office, City Hall, Everett.

LEONARD F. GLAVIN.

Registration Clerk, — Labor Office, City Hall, Worcester.

WILLIAM B. CONNOR.

Examiners.

For the Commonwealth and Boston Services.

William D. Hawley.
Frederick G. Pettigrove.
Frederick L. Coburn.
Charles E. Davis, Jr.
J. Francis Dustan.
Charles R. Brown.
Anne M. Robbins.
Carrie B. Cole.
James W. Ricker.
Elizabeth C. Putnam.
Benjamin Pettee.
Zilpha D. Smith.
James Tucker.
Lemuel Pope.
Xanthus H. Goodnough.
Samuel A. Green.
John F. Tyler.
John H. McCollom.
Russell D. Elliott.
Henry M. Nourse.
Joseph D. Fallon.
William F. Davis.
Henry Manley.
John F. Dever.
George H. Grueby.
J. Henry Adams.
Alexander Burr.
Charles G. Davis.
Dwight Porter.
S. Everett Tinkham.
William T. Sedgwick.
Frank A. McInnes.
David Craig.
Arthur P. Russell.

Augustus H. Brown, M.D., *Physical Examiner.*

Andrew J. Savage, *Examiner in the Use and Handling of Steam.*

Charles A. Legg, *Examiner in Electrical Engineering.*

For the City of Beverly.

Linville H. Wardwell, *Sec'y.*
Dudley N. Griffin.
Charles F. Lee.

For the City of Brockton.

DeWitt C. Packard, *Secretary.*
Augustus T. Jones.
Warren Goddard.

For the Town of Brookline.

Zephaniah R. Forbes, *Secretary.*
William H. White.
Benjamin S. Blanchard.

For the City of Cambridge.

Charles H. Morse, *Secretary.*
Archibald M. Howe.
Michael Corcoran.
William T. Piper.

For the City of Chelsea.

D. Frank Kimball, *Secretary.*
Frank B. Fay.

For the City of Chicopee.

Cornelius J. Driscoll, *Sec'y.*
Frederick L. Hinkley.
Alfred L. Pomeroy.

For the City of Everett.

Wilmot R. Evans, Jr., *Secretary.*
Daniel B. Fessenden.
Woodbury A. Ham.
Thomas F. Garvey.

For the City of Fall River.

Edward F. Murphy, *Secretary.*
William B. Lovell.
Charles J. Holmes.

For the City of Fitchburg.

Walter A. Davis, *Secretary.*
John J. Sheehan.
Frederick Fosdick.
John E. Dwyer.

For the City of Gloucester.

Charles H. Morrow, *Secretary.*
William A. Homans, Jr.
Frederick A. Pearce.

EXAMINERS — *Continued.*

For the City of Haverhill.

EDWARD B. SAVAGE, *Secretary.*
LORENZO FROST.
PHILIP C. SWETT.

For the City of Holyoke.

ASHTON E. HEMPHILL, *Secretary.*
WILBERT T. DEAN.
ADDISON L. GREEN.
ISAAC E. SAWYER.

For the City of Lawrence.

WILLIAM T. KIMBALL, *Secretary.*
JOHN J. DONOVAN.
FRED H. EATON.

For the City of Lowell.

CHARLES H. CONANT, *Secretary.*
JOHN J. COLTON.
JOSEPH SMITH.

For the City of Lynn.

WALTER E. SYMONDS, *Secretary.*
RUFUS KIMBALL.
GEORGE BRICKETT.

For the City of Malden.

JACOB C. PATTON, *Secretary.*
JAMES O. OTIS.
HENRY E. TURNER, Jr.

For the City of Marlborough.

GEORGE L. STEVENS, *Secretary.*
WILLIAM L. MORSE.
JOHN L. STONE.

For the City of Medford.

ERNEST B. MOORE, *Secretary.*
JAMES MOTT HALLOWELL.
ALLSTON P. JOYCE.

For the City of Melrose.

WALTER DEHAVEN JONES, *Sec'y.*
WILLIAM A. DOLE.

For the Town of Milton.

JOHN F. BROWN.
EMORY L. MEAD.
THOMAS K. CUMMINS, Jr.

For the City of New Bedford.

RUFUS H. WILLIS, *Secretary.*
DANIEL B. LEONARD.
ALBERT B. DRAKE.

For the City of Newburyport.

OLIVER B. MERRILL, *Secretary.*
HENRY B. LITTLE.
JOHN F. YOUNG.

For the City of Newton.

JOHN C. BRIMBLECOM, *Secretary.*
DWIGHT CHESTER.
FRANCIS GEO. CURTIS.

For the City of North Adams.

GEORGE FRENCH, *Secretary.*
ARTHUR W. CHIPPENDALE.
OSCAR A. ARCHER.

For the City of Northampton.

JOHN W. MASON, *Secretary.*
MELVIN L. GRAVES.

For the City of Pittsfield.

LOUIS B. CUMMINGS, *Secretary.*
MORRIS SCHAFF.
JOSEPH TUCKER.
STEPHEN C. BURTON.

For the City of Quincy.

CHRISTOPHER A. SPEAR, *Sec'y.*
HARRY L. RICE.
LUTHER S. ANDERSON.

For the Town of Revere.

ALBERT S. BURNHAM, *Secretary.*
ROGERS DOW.
F. IRVING WESTON.
ALBERT FITZEMEYER.
FRED W. JANVRIN.

EXAMINERS — *Concluded.*

For the City of Salem.

EDWARD F. BROWN, *Secretary.*
JOSEPH P. FESSENDEN.
CLIFFORD BRIGHAM.

For the City of Somerville.

GEORGE I. VINCENT, *Secretary.*
HORACE C. WHITE.
EDWARD C. BOOTH.

For the City of Springfield.

CHARLES H. CHURCHILL, *Sec'y.*
ALBERT T. FOLSOM.
FREDERICK H. STEBBINS.

For the City of Taunton.

MARTIN J. LINCOLN, *Secretary.*
ABNER COLEMAN.
JOHN E. BROWNE.

For the City of Waltham.

LUMAN N. HALL, *Secretary.*
CORNELIUS McCORMICK.
CHARLES F. A. SMITH.

For the City of Woburn.

ALBERT P. BARRETT, *Secretary.*
HERBERT B. DOW.
FRANCIS A. PARTRIDGE.

For the City of Worcester.

FRANK B. HALL, *Secretary.*
JAMES EARLY.
JOHN P. MUNROE.

SCHEDULE OF EXAMINATIONS.

In giving notice of the competitive examinations to be held in the cities and towns, and at the times mentioned in the following schedule, the commissioners reserve the right to order such additional or other examinations as the public service may require, or to change the time of any examination upon reasonable notice.

SCHEDULE OF EXAMINATIONS, BY DATES.

1902.

Jan. 7. Revere, police, fire.
9. Holyoke, police, foremen, inspectors of work.
10. Holyoke, clerks, messengers, school-house janitors.
13. Lawrence, police.
14. Lawrence, clerks, messengers, foremen, inspectors of work.
20. Commonwealth, foremen, inspectors of work, sub-foremen.
21. Boston, foremen, inspectors of work, sub-foremen.
23. Boston, civil engineers.
24. Boston, civil engineers.
25. Boston, civil engineers.
27. Milton, police, fire.
28. Boston, drawtenders, assistant drawtenders.
Feb. 3. Brockton, clerks, messengers, foremen, inspectors of work.
4. Chelsea, clerks, messengers, police, foremen, inspectors of work.
4. Cambridge, foremen, inspectors of work.
5. Somerville, foremen, inspectors of work.
6. Somerville, police.
10. Waltham, clerks, messengers, foremen, inspectors of work.
12. Fitchburg, police, foremen, inspectors of work.
13. Somerville, clerks, messengers.
17. Salem, police.
18. Salem, clerks, messengers, foremen, inspectors of work.
20. Pittsfield, police, clerks, messengers, foremen, inspectors of work.
24. Marlborough, police, clerks, messengers, foremen, inspectors of work.
Mar. 4. Fitchburg, clerks, messengers.
6. Lowell, clerks, messengers, foremen, inspectors of work.
11. Malden, police, foremen, inspectors of work.

1902.

Mar. 13. Commonwealth, metropolitan park police.
14. Commonwealth, prison service.
14. Boston, prison service.
18. Boston, fire.
19. Boston, police.
21. Springfield, foremen, inspectors of work.
24. Brookline, clerks, messengers, police, fire, foremen, inspectors of work.
26. Medford, police, clerks, messengers, foremen, inspectors of work.
April 1. Lowell, police.
3. Fall River, police.
4. Cambridge, police, fire.
7. Boston, clerks, messengers.
8. Commonwealth, clerks, messengers.
9. Boston, clerks, messengers.
10. Commonwealth, clerks, messengers.
15. Boston, stenographer-typewriters.
16. Commonwealth, stenographer-typewriters.
17. Chicopee, police, clerks, messengers, foremen, inspectors of work.
23. Cambridge, clerks, messengers.
28. Quincy, clerks, messengers, foremen, inspectors of work.
29. Quincy, police, fire.
May 1. Boston, truant officers.
6. Newton, clerks, messengers.
7. Newton, police, foremen, inspectors of work.
13. Haverhill, clerks, messengers.
15. Brockton, police.
16. Melrose, police, clerks, messengers, foremen, inspectors of work.
19. New Bedford, police.
20. New Bedford, fire.
22. Commonwealth, foremen, inspectors of work, sub-foremen.
23. Boston, foremen, inspectors of work, sub-foremen.
28. Haverhill, police, foremen, inspectors of work.
June 2. Boston, civil engineers.
3. Boston, civil engineers.
4. Boston, civil engineers.
6. Boston, school-house janitors.
18. North Adams, police.
19. North Adams, clerks, messengers, foremen, inspectors of work.
Sept. 16. Springfield, police.
17. Springfield, clerks, messengers, foremen, inspectors of work.
22. Boston, fire.
23. Boston, police.
26. Boston, drawtenders, assistant drawtenders.
29. Boston, clerks, messengers.
30. Commonwealth, clerks, messengers.

1902.
Oct. 1. Boston, clerks, messengers.
2. Commonwealth, clerks, messengers.
7. Boston, stenographer-typewriters.
8. Commonwealth, stenographer-typewriters.
10. Worcester, police.
14. Fall River, clerks, messengers, foremen, inspectors of work.
15. Everett, police, clerks, messengers, foremen, inspectors of work.
22. New Bedford, clerks, messengers, foremen, inspectors of work.
24. Cambridge, drawtenders, school-house janitors.
28. Malden, clerks, messengers.
Nov. 5. Lynn, police.
6. Lynn, clerks, messengers, foremen, inspectors of work.
11. Gloucester, police, foremen, inspectors of work.
12. Gloucester, clerks, messengers.
14. Woburn, police, clerks, messengers, foremen, inspectors of work.
18. Northampton, police, clerks, messengers, foremen, inspectors of work.
25. Beverly, police, clerks, messengers, foremen, inspectors of work.
Dec. 4. Waltham, police.
5. Somerville, fire.
11. Taunton, police.
12. Taunton, clerks, messengers, foremen, inspectors of work.
16. Worcester, clerks, messengers.
17. Worcester, foremen, inspectors of work.
19. Newburyport, clerks, messengers, police, foremen, inspectors of work.

SCHEDULE OF EXAMINATIONS FOR THE SERVICE OF THE COMMONWEALTH AND THE SEVERAL CITIES.

Commonwealth.

1902.
Jan. 20. Foremen, inspectors of work, sub-foremen, schedule B, classes 6 and 7.
Mar. 13. Metropolitan park police, schedule B, class 1.
14. Prison service, schedule B, class 1.
Apr. 8. Clerks, messengers, schedule A, class 1.
10. Clerks, messengers, schedule A, class 2.
16. Stenographer-typewriters, schedule A, class 4.
May 22. Foremen, inspectors of work, sub-foremen, schedule B, classes 6 and 7.
Sept. 30. Clerks, messengers, schedule A, class 1.
Oct. 2. Clerks, messengers, schedule A, class 2.
8. Stenographer-typewriters, schedule A, class 4.

It was predicted by ~~the~~ those
who advocating the enactment
~~advocates~~ of the civil-service law
unjust — that the temptation to make removals
removal of the/ — would gradually disappear with the power
to control appointments to
thus made vacant/positions. This prediction
has been largely fulfilled. The
civil-service act did not ~~provide for retaining~~ intend that
Should be/ retained/ — incompetent persons in office.
The authority of removal and its exercise for proper reasons ~~is~~ are necessary
for the efficiency and the
tr. public/ — discipline of the service. The
power of removal is not affected
tr. — by the rules or the law further than ~~except~~
that ~~no~~ removals shall not be made
tr. — for religious or political reasons.
present/ — The results under the ~~new~~ system
are in every respect more satisfactory than

old/ under the ~~other~~ system.

in the rules/ There are restrictions in regard

persons/ to the reinstatement of ~~those~~

who have been dismissed ~~discharged~~ for

delinquencies or misconduct,

while inefficient employees

under the old system + persons

who should have been discharged

in office for delinquencies or misconduct were not only kept without

regard to their failings, but

dismissed/ when some of them were ~~discharged~~

for proper ~~good~~ reasons, they often had suf-

political or other/ ficient influence to get back into ~~return to~~

the service. Such reinstate-

ments cannot now be made under

civil service/ the ~~present~~ rules

Lowell.

1902.
Mar. 6. Clerks, messengers, schedule A, classes 1 and 2.
6. Foremen, inspectors of work, schedule B, class 6.
Apr. 1. Police, schedule B, class 3.

Lynn.

1902.
Nov. 5. Police, schedule B, class 3.
6. Clerks, messengers, schedule A, classes 1 and 2.
6. Foremen, inspectors of work, schedule B, class 6.

Malden.

1902.
Mar. 11. Police, schedule B, class 3.
11. Foremen, inspectors of work, schedule B, class 6.
Oct. 28. Clerks, messengers, schedule A, classes 1 and 2.

Marlborough.

1902.
Feb. 24. Police, schedule B, class 3.
24. Clerks, messengers, schedule A, classes 1 and 2.
24. Foremen, inspectors of work, schedule B, class 6.

Medford.

1902.
Mar. 26. Police, schedule B, class 3.
26. Clerks, messengers, schedule A, classes 1 and 2.
26. Foremen, inspectors of work, schedule B, class 6.

Melrose.

1902.
May 16. Police, schedule B, class 3.
16. Clerks, messengers, schedule A, classes 1 and 2.
16. Foremen, inspectors of work, schedule B, class 6.

Milton.

1902.
Jan. 27. Police, schedule B, class 3.
27. Fire, schedule B, class 9.

New Bedford.

1902.
May 19. Police, schedule B, class 3.
20. Fire, schedule B, class 9.
Oct. 22. Clerks, messengers, schedule A, classes 1 and 2.
22. Foremen, inspectors of work, schedule B, class 6.

Newburyport.

1902.
Dec. 19. Clerks, messengers, schedule A, classes 1 and 2.
19. Police, schedule B, class 3.
19. Foremen, inspectors of work, schedule B, class 6.

Newton.

1902.
May 6. Clerks, messengers, schedule A, classes 1 and 2.
7. Police, schedule B, class 3.
7. Foremen, inspectors of work, schedule B, class 6.

North Adams.

1902.
June 18. Police, schedule B, class 3.
19. Clerks, messengers, schedule A, classes 1 and 2.
19. Foremen, inspectors of work, schedule B, class 6.

Northampton.

1902.
Nov. 18. Police, schedule B, class 3.
18. Clerks, messengers, schedule A, classes 1 and 2.
18. Foremen, inspectors of work, schedule B, class 6.

Pittsfield.

1902.
Feb. 20. Police, schedule B, class 3.
20. Clerks, messengers, schedule A, classes 1 and 2.
20. Foremen, inspectors of work, schedule B, class 6.

Quincy.

1902.
Apr. 28. Clerks, messengers, schedule A, classes 1 and 2.
28. Foremen, inspectors of work, schedule B, class 6.
29. Police, schedule B, class 3.
29. Fire, schedule B, class 9.

Revere.

1902.
Jan. 7. Police, schedule B, class 3.
7. Fire, schedule B, class 9.

Salem.

1902.
Feb. 17. Police, schedule B, class 3.
18. Clerks, messengers, schedule A, classes 1 and 2.
18. Foremen, inspectors of work, schedule B, class 6.

Somerville.

1902.
Feb. 5. Foremen, inspectors of work, schedule B, class 6.
6. Police, schedule B, class 3.
13. Clerks, messengers, schedule A, classes 1 and 2.
Dec. 5. Fire, schedule B, class 9.

Springfield.

1902.
Mar. 21. Foremen, inspectors of work, schedule B, class 6.
Sept. 16. Police, schedule B, class 3.
17. Clerks, messengers, schedule A, classes 1 and 2.
17. Foremen, inspectors of work, schedule B, class 6.

Taunton.

1902.
Dec. 11. Police, schedule B, class 3.
12. Clerks, messengers, schedule A, classes 1 and 2.
12. Foremen, inspectors of work, schedule B, class 6.

Waltham.

1902.
Feb. 10. Clerks, messengers, schedule A, classes 1 and 2.
10. Foremen, inspectors of work, schedule B, class 6.
Dec. 4. Police, schedule B, class 3.

Woburn.

1902.
Nov. 14. Police, schedule B, class 3.
14. Clerks, messengers, schedule A, classes 1 and 2.
14. Foremen, inspectors of work, schedule B, class 6.

Worcester.

1902.
Oct. 10. Police, schedule B, class 3.
Dec. 16. Clerks, messengers, schedule A, classes 1 and 2.
17. Foremen, inspectors of work, schedule B, class 6.

No applicant shall have the right to examination, unless the application is filed, under the rules, at least one week before the examination; *provided*, that the commissioners or the chief examiner, for cause shown, may allow a person making an application at a later time to take the examination.

WARREN P. DUDLEY,
Secretary.

It was predicted by ~~the~~ those who advocated the enactment ~~advocates~~ of the civil-service law

unjust — that the temptation to make removals

removal of the/ — would gradually disappear with the power to control appointments to thus made vacant positions. This prediction has been largely fulfilled. The

civil-service act did not ~~provide for retaining~~ intend that

Should be retained/ — incompetent persons in office. The authority of removal and its exercise for proper reasons ~~is~~ are necessary for the efficiency and the

tr.

public/ — discipline of the service. The power of removal is not affected

tr. — by the rules or the law ~~except~~ further than that ~~no~~ removals shall not be made

tr. — for religious or political reasons.

present/ — The results under the ~~new~~ system are in every respect more satisfactory than old/ under the ~~other~~ system.

in the rules/ There are restrictions in regard

persons/ - to the reinstatement of ~~those~~

who have been dismissed ~~removed~~ for

delinquencies or misconduct,

while inefficient employees,

under the old system & persons

who should have been discharged

in office for delinquencies or misconduct, were not only kept without

regard to their failings, but

dismissed/ when some of them were ~~discharged~~

for ~~good~~ proper reasons, they often had suf-

political or other/ ficient influence to get back into ~~return to~~

the service. Such reinstate-

ments cannot now be made under

civil service/ the ~~present~~ rules

EXAMINATION PAPERS.

SCHEDULE A — CLASS 1.

[Limited Examination.]

Clerical Service.

First Subject:

Writing from dictation.

One of the examiners will read, so distinctly that each person being examined can hear him, one of the exercises for dictation. In general, not more than twenty words per minute will be read, nor more than five or six words without pause. After the reading, five minutes will be allowed for punctuation.

[*To Applicant.* Write as much as you can of the passage read. If from any cause you miss a word, do not pause, but go on with the next words you hear. *Write clearly; spell and punctuate correctly. Use no abbreviations.*]

Spelling. Usually twenty words, announced by the examiner.

Rough draft. Making a fair copy of the rough draft of a letter or report, writing out all abbreviations in full, and inserting the added or corrected parts in their proper places. *No changes in punctuation or capitals are to be made.*

Handwriting; shown in copying rough draft.

Second Subject:

1. Write in figures the following number: —

   Two hundred six million ten thousand three and forty-three forty-fourths.

   Write in words the number expressed by the following figures: — 5,003,001.0006

2. Add these *across*, placing the totals in the spaces indicated; then add the totals: —

						Totals.
21,247	15,365	20,064	18,653	7,492	35,688	
18,365	14,844	9,875	22,350	32,645	24,463	
12,422	13,456	27,378	8,664	17,843	18,845	
21,450	19,864	31,647	22,320	4,745	23,343	
27,765	18,946	22,462	5,438	34,016	18,418	

3. What is the sum of $\frac{27}{35}$, $\frac{3}{14}$, $\frac{2}{5}$ and $\frac{13}{20}$. *Give the work in full, using the lowest common denominator. The answer must be a mixed number.*

   What fraction of a dollar must be added to $\frac{1}{3}$ of a dollar to make 75 cents? *Give the work in full. The answer must be a common fraction.*

4. What is the cost of $8\frac{3}{7}$ tons of hay at $\$16\frac{1}{3}$ a ton. Use common fractions. *Give the work in full.*

   Reduce $\frac{1}{5} \div \frac{2\frac{1}{3}}{15\frac{1}{4}}$. *Give the work in full. The answer must be a mixed number.*

5. Divide four hundred twenty and fifty-six hundredths by twelve and sixteen thousandths, and subtract $24\frac{7}{8}$ from the amount. *Use decimals. Give the work in full.*

   Multiply sixty-four by three hundred seventy-five ten-thousandths. *Use decimals. Give the work in full.*

6. What number exceeds the sum of its fourth, fifth and sixth parts by 161? *Give the work in full.*

7. A grocer bought 128 gallons of molasses at $0.64 per gallon, and paid $2.08 for cartage. He lost 16 gallons by leakage. At what price must he sell the remainder so as to gain $\frac{1}{6}$ of the entire cost? *Give the work in full.*

8. A room is 31 feet 6 inches long; what is its width if the floor area is 84 square yards? *Give the work in full.*

9. By selling an estate for $13,397.50 I made a profit of 15 per cent. on the price paid for it; what was that price? *Give the work in full.*

10. By selling a horse for $218.75 I lost $12\frac{1}{2}$ per cent. of the cost; what was the cost? *Give the work in full.*

Third Subject:

Writing a letter on some subject given at the examination.

[This exercise is designed chiefly to test the applicant's skill in English composition, knowledge of the use of punctuation marks and capitals, paragraphing, etc.]

The letter should be signed with the applicant's number, not his name.

SCHEDULE A — CLASS 2.*

[General Examination.]

Clerical Service.

First Subject:

Writing from dictation.

One of the examiners will read, so distinctly that each person being examined can hear, one of the exercises for dictation. In general, not more than twenty words per minute will be read, nor more than five or six words without pause. After the reading, five minutes will be allowed for reviewing the work.

[*To Applicant.* Write as much as you can of the passage read. If from any cause you miss a word, do not pause, but go on with the next words you hear. *Write clearly; spell and punctuate correctly. Use no abbreviations.*]

Spelling. Usually twenty words, announced by the examiner.

Rough draft. Making a fair copy of the rough draft of a letter or report, writing out all abbreviations in full, and inserting the added or corrected parts in their proper places. *No changes in punctuation or capitals are to be made.*

Second Subject:

1. Write in figures the following number: —

   One hundred two billion five million thirteen thousand three and two-hundred-sixty-one three-hundred-forty-thirds.

   Write in words the number expressed by the following figures: — 3,005,010,001.00004

2. Add these *across*, placing the totals in the spaces indicated; then add the totals: —

						Totals.
22,847	16,830	7,543	16,398	36,656	21,475	
28,458	8,864	42,260	38,696	133,408	38,650	
18,395	23,476	23,654	6,585	38,680	134,784	
21,187	38,685	76,654	142,348	23,234	8,548	
28,560	42,850	86,586	28,392	9,463	125,574	

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* To become eligible, applicants who take the general examination must obtain sixty-five per cent. in each of the first three subjects.

3. To $\frac{4}{5}$ of $\frac{5}{8}$ add $\frac{4}{11}$ of $\frac{22}{63}$. *Give the work in full.*

   By what fraction must $\frac{3\frac{10}{37}}{\frac{33}{74}}$ be multiplied, that the product shall be 1? *Give the work in full.*

4. $189\frac{7}{8}$ acres are $89\frac{23}{24}$ acres more than $\frac{11}{36}$ of Smith's land; how many acres are there in Smith's land? *Give the work in full.*

5. Add thirty-three and forty-five hundred-thousandths, four and fifteen ten-thousandths, one hundred seven and fifteen thousandths, three hundred fifty-five millionths; divide the amount by five-tenths, and subtract eighteen and three-eighths. *Give the work in full. Use decimals.*

6. What will it cost to cut a road through a hill, the depth of the cut being 15 feet, the average width 20 feet, and the length of the road 40 yards, at 66 cents a cubic yard? *Give the work in full.*

7. A salt-dealer put up 56,000 pounds of salt in 20-pound, 10-pound and 5-pound boxes, using the same number of each size. How many boxes of each size did he put up? *Give the work in full.*

8. An agent is entrusted with $3,762.88 and instructed to buy flour at $5.25 a barrel. The freight is $250, and the agent charges 2 per cent. commission. How many barrels of flour does he buy? *Give the work in full.*

9. If I sell $1,250 worth of my property, the value of the remainder will be $87\frac{1}{2}$ per cent. of the whole property. What is the value of the whole? *Give the work in full.*

10. The tax on the real estate of a town amounts to $65,675; the rate per thousand dollars is $18.50; what is the assessed value? *Give the work in full.*

Third Subject:

1. Find the simple interest on $675 for 2 years, 3 months and 18 days, at the rate of $4\frac{1}{2}$ per cent. a year. *Give the work in full.*

2. A 6 months note for $2,050, dated January 3, was discounted at a Boston bank March 8, at the rate of 6 per cent. Find the proceeds. *Give the work in full.*

3. Find the difference between the simple and the compound interest on $450 for 2 years and 6 months, the rate being 6 per cent. *Give the work in full.*

4. If the proceeds of a 5 months note, discounted at a Boston bank the day it was dated, at the rate of 7 per cent., were $970.83, what was the face of the note? *Give the work in full.*

5. I can invest $19,964 in 6 per cent. stock selling at 108½, or in 5 per cent. stock selling at 92; which will yield the greater income, and how much greater will it be? *Give the work in full.*

Fourth Subject:

Writing a letter on some subject given at the examination.

[This exercise is designed chiefly to test the applicant's skill in English composition, knowledge of the use of punctuation marks and capitals, paragraphing, etc.]

The letter should be signed with the applicant's number, not his name.

SCHEDULE A — CLASS 3.

Inspector: Water Department.

First Subject:

State how long you have resided in this city and what your trade or occupation has been since you began to earn your living.

If you have learned a trade, state where and under whom you learned it and how long you worked at it.

If you have had any practical experience in the duties of the office for which you apply, or of any similar office, state when, where, for how long and under whom you had it.

State also any experience you may have obtained in business life or in the superintendence of others, either in public or private business.

If you are familiar with any foreign language, state what language it is.

Write not less than ten lines. Do not sign your name.

[On this the applicant is marked for clearness and correctness of statement, and for experience.]

Second Subject:

1. Write in figures the following number: —
   One hundred eleven thousand three hundred six.
   Write in words the number expressed by the following figures: — 49,852
2. Add the following column of figures: — 27,896
   35,427
   12,397
   75,556
   29,872
   12,387

3. An army of 10,000 men lost 4,809 men in battle; how many men were left? *Give the work in full.*
4. How much will 72 barrels of flour weigh, if each barrel weighs 196 pounds? *Give the work in full.*
5. How many horses worth $125 apiece must be given for a farm worth $11,000? *Give the work in full.*
6. What will be the cost of 32 pounds of coffee at 28⅜ cents a pound? *Give the work in full.*

Third Subject:

Copying a printed statement, thus showing handwriting and accuracy in copying.

Fourth Subject:

Questions to test the applicant's knowledge of the water service, causes of waste, etc.

Fifth Subject:

Reading a water meter.

SCHEDULE A — CLASS 3.

Inspector: Health Department.

First, second and third subjects: — Letter-writing, spelling, handwriting, arithmetic.

Fourth Subject:

Questions relating to the duties of health inspector; contagious diseases; fumigation and purification; ventilation, disinfectants, etc.

SCHEDULE A — CLASS 3.

Almoner, Agent, Inspector, Visitor: Department of Overseers of the Poor.

First Subject:

Writing from dictation.
Spelling.

Second Subject:

Letter-writing.
Experience.

Third Subject:

1. Write in figures the following amount: —
   Four thousand six dollars and nine cents.
   Write in words the number expressed by the following figures: — 60,010
2. Add the following column: —

   $287.46
   1,349.82
   2,386.95
   689.73
   1,055.28
   964.13
3. If the salaries of 2,010 teachers amount to $1,055,752.50, what is the average salary of each? *Give the work in full.*
4. A farmer bought 25 cows at $37.75 apiece, and a number of others at $25 apiece; how many cows in the second lot, if the whole cost was $4,668.75? *Give the work in full.*
5. A merchant sold $182\frac{1}{2}$ pounds of sugar, $12\frac{3}{4}$ pounds of cheese and $37\frac{1}{8}$ pounds of tea; how many pounds did he sell in all? *Give the work in full.*

Fourth Subject:

Handwriting: shown by copying printed matter.

Special Subject:

Questions relating to the settlement and pauper laws.

SCHEDULE A — CLASS 4.

Stenographer-Typewriter.

First Subject:

Copying printed matter, thus showing handwriting and accuracy in copying. Spelling: twenty words announced by the examiner.

Second Subject:

1. Write in figures the following number: —
   One hundred three million four thousand two and thirty-one seventy-fifths.
   Write in words the number expressed by the following figures: — 9,001,010.0012

2. Add these *across*, placing the totals in the space indicated; then add the totals: —

						Totals.
42,753	36,840	17,865	9,476	327,685	35,782	
36,415	32,264	74,322	3,482	22,690	24,969	
34,820	21,140	8,742	227,865	46,650	3,764	

3. What is the sum of $\frac{23}{24}$, $\frac{5}{7}$, $\frac{5}{8}$, and $\frac{13}{21}$? *Give the work in full, using the lowest common denominator. The answer must be in a mixed number.*
4. What is the cost of $19\frac{3}{7}$ tons of coal at $\$5\frac{3}{8}$ a ton? *Give the work in full. Use common fractions.*
5. To fifteen and fifty-three thousandths add six and forty-six ten-thousandths, divide the amount by three-hundredths and subtract three hundred fifty and five-eighths. *Give the work in full. Use decimals.*
6. What fraction multiplied by $3\frac{4}{7}$ equals $\frac{5\frac{1}{6}}{\frac{2}{5}}$? *Give the work in full.*
7. How many cubic yards of stone are contained in a wall 214 feet 4 inches long, 9 feet high and 3 feet 4 inches thick? *Give the work in full.*
8. If a pole $10\frac{1}{3}$ feet high casts a shadow $6\frac{1}{2}$ feet long, what is the height of a house which casts a shadow 39 feet long at the same hour? *Give the work in full.*
9. By selling a house for $8,437.50, I make a profit of $12\frac{1}{2}$ per cent.; what was the cost? *Give the work in full.*
10. If a man sells a horse for $220, he gains 10 per cent.; what per cent. will he gain or lose if he sells it for 10 per cent. less than $220? *Give the work in full.*

Special Subject:

Short-hand writing and type-writing. Two tests of skill and accuracy in taking short-hand notes are given, one at the rate of 100 words and one at the rate of 120 words a minute. These notes are then transcribed by the use of the type-writing machine.

Type-writing printed matter, showing accuracy, speed, and technique.

Tabulating, transcribing rough draft of a report, and making corrected copy of a rough unpunctuated letter.

Test of speed in type-writing from dictation.

SCHEDULE A — CLASS 5.

Messengers.

For positions as messengers, where the annual pay is at the rate of $800 or less, the same examination as for Schedule A, class 1.

For positions as messengers, where the annual pay is at the rate of more than $800, the same examination as for Schedule A, class 2.

SCHEDULE B — CLASS 1.

Prison Service.

First Subject:

Writing from memory the substance of matter orally communicated.

Second Subject:

The answers to the questions on this sheet will be marked as a whole under two heads, — EXPERIENCE, and CLEARNESS AND CORRECTNESS OF STATEMENT. *Any false statement made by the applicant in answering these questions will be regarded as good cause for excluding him from the eligible list, or for removal or discharge during probation or thereafter.*

1. State in general terms your occupation since you became of age, and any experience you may possess which will be of use, if you should receive an appointment in the prison service.
2. If you have ever served in the prison department in any capacity, or in any public office, state when, where, how long, whether you were ever discharged for cause, or requested to resign; and whether, while in office, you were ever complained of for violation of the rules of the office, or for any conduct unbecoming an officer; and, if such complaint was made, what action was taken thereon.
3. Have you ever been convicted of any offence against the laws of this or any other State or nation?
4. Have you ever been a dealer in intoxicating liquors, or a bar-tender? If so, when, where and for how long?
5. Do you ever drink distilled or fermented liquors of any kind? If so, state fully and definitely what your habits are in such use of them. If you are a total abstainer, state how long you have abstained.

6. Have you served in the army or navy of the United States, either in time of peace or war; and, if so, how long did you serve, and in what capacity, and did you receive an honorable discharge therefrom?
7. If you have ever served in the volunteer militia, name the regiment and company, and state how long and in what capacity you served, and whether you have been honorably discharged, been dismissed, have resigned or been asked to resign.
8. Have you ever had the handling of men, either in public office or private employment?

Third Subject:

1. Write in figures the following numbers: —
   Two thousand seven hundred forty-two.
   Six hundred seventy dollars three cents.
2. Write in words the numbers expressed by the following figures: — 3,742
   $693.51
3. Add the following column of figures: — 375
   2,146
   1,989
   2,432
   867
   1,233
4. From 27,321 subtract 18,465. *Give the work in full.*
5. Divide 1,554 by 42. *Give the work in full.*
6. Multiply 305 by 46. *Give the work in full.*
7. If a man works twenty-six days at two dollars and twenty-five cents per day, how much money will he earn? *Give the work in full.*

Fourth Subject:

Copying a printed statement, thus showing handwriting and accuracy in copying.

PHYSICAL EXAMINATION.

SCHEDULE B — CLASS 1.

The Applicant will fill out this portion of the blank.

Name,
Date of birth,
Occupation,
Have you any disease now?
What diseases have you had during the last seven years?
Have you varicose veins or hernia?
Have you ever had fits?
Have you ever had any fracture or dislocation?
Have you ever received any injury to the head or spine?
Are you subject to piles?
Have you been vaccinated?
Have you ever had rheumatism?

	WEIGHT.	HEIGHT.		C.†	
*STATE THE EXACT weight, A; height, B; circumference of chest, C.	A.	B. Feet.	Inches.	At forced expiration, On full inspiration,	Inches. "

A. IS THE RESPIRING murmur clear and distinct over both lungs? B. Is the character of the respiration full, easy, and regular? C. Are there any indications of disease of the organs of respiration or their appendages?	A. B. C.
A. IS THE CHARACTER of the heart's action uniform, free and steady? B. Are its sounds and rhythm regular and normal? C. Are there any indications of disease of this organ or of the blood vessels?	A. B. C.
A. IS THE SIGHT GOOD? B. Is the hearing good?	A. B.
IS THE APPLICANT subject to cough, expectoration, difficulty of breathing, or palpitation?	
A. ARE THE FUNCTIONS of the brain and nervous system in a healthy state? B. Has the brain or spinal cord ever been diseased?	A. B.
IF THE APPLICANT has had any serious illness or injury, state expressly what effect, if any, is perceptible in the heart, lungs, kidneys or other abdominal organs, or the skin, eyes, ears, limbs, etc.	
HAS THE APPLICANT any predisposition, either hereditary or acquired, to any constitutional disease, as phthisis, scrofula, rheumatism?	

DOES THE APPLICANT display any evidence of having or having had syphilis? ‡	
HABITS, use of stimulants and tobacco.	
HAS THE APPLICANT any peculiarities in his walk or general carriage or of facial expression or marks, which would make him an object of remark?	

* The examiners are called upon to pay special attention to the annexed schedule in determining the fitness of the applicant.

† There should be a difference, at least, of two inches at forced expiration and on full inspiration. All examinations of the chest should be made on the bare body, and not through the clothing.

‡ Syphilitic taint in the applicant must always be regarded as good cause of rejection.

** Obesity must be regarded as a good cause for rejection.

† Minimum circumference of the chest tolerable in applicants.

HEIGHT.		CIRCUMFERENCE OF CHEST.
Feet.	Inches.	Inches.
5	8	34
5	9	34½
5	10	35
5	11	35½
6	–	36
6	1	36½
6	2	37
6	3	37½
6	4	38

Stature and Weight. – The stature shall not be below 5 ft. 8 in., in ordinary dress, nor the weight below that marked as its minimum accompaniment in the subjoined table: **

HEIGHT.		MIN. WEIGHT.
Feet.	Inches.	Pounds.
5	8	140
5	9	145
5	10	150
5	11	155
6	–	160
6	1	165
6	2	170
6	3	175
6	4	180

(*a*) In examining the sense of sight, not only shall the general condition of the organs be ascertained, but weight shall be given to quickness and accuracy in discriminating colors and distances. The hearing shall be tested also as to keenness and correctness in distinguishing degrees and kinds of sounds, and the direction from which they come.

Remarks.

I,   , hereby declare that I have returned true answers to the inquiries of   touching my personal and family health, history, habits, and antecedents; and that I am the person described in the foregoing record of examination.

Certificate of Examining Surgeon.

I hereby certify that I have this day carefully and thoroughly examined, in accordance with the foregoing instructions,   , and find that he is   sound in limb and body, is   able bodied   of a robust constitution, has   good eyesight and   good hearing, and in my opinion is   physically qualified to sustain the labors and exposures, and perform the duties of a prison officer, and that the above is a truthful record of the examination.

Medical Examiner.

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SCHEDULE B — CLASS 1.

*Metropolitan Park Police.**

The same test, educational, physical and in development and strength, as are applied to applicants for the police force of Boston, Schedule B, Class 4.

SCHEDULE B — CLASS 2.

Fire Department of Boston.

For Admission to the Force as Call-man or Permanent Substitute.

First Subject:

Copying a printed statement, thus showing handwriting and accuracy in copying.

Second Subject:

The answers to the questions on this sheet will be marked as a whole under two heads, — EXPERIENCE, and CLEARNESS AND CORRECTNESS OF STATEMENT. *Any false statement made by the applicant in answering these questions will be regarded as good cause for excluding him from the eligible list, or for removal or discharge during probation or thereafter.*

Write a letter to the mayor of Boston, giving as complete an account as possible of your school experience; also of the various occupations in which you have been engaged since you began to earn your own living, the firm or corporation by whom employed and the length of time at each service.

Have you ever done fire duty in any capacity, or been employed in any public office? If so, state when, where, how long, whether you were ever discharged for cause, or requested to resign; and whether, while in office, you were ever complained of for violation of the rules of the office, or for any conduct unbecoming an officer; and, if such complaint was made, what action was taken thereon.

Have you ever had any experience which, in your opinion, particularly fits you for the fire service? If so, state the same fully.

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* Each applicant for metropolitan park police service will be examined upon definitions of crimes, descriptions of legal papers and the duties of police officers, and he is entitled to receive from the commissioners a pamphlet containing the necessary information, after filing his application.

When were you born? Give month, day and year.

Where were you born?

Have you ever served in the volunteer militia? If so, name the regiment and company, and state how long and in what capacity you served, and whether you have been honorably discharged, been dismissed, have resigned or been asked to resign.

Have you ever been convicted of any offence against the laws of this or any other State or nation? If so, make a full statement of the case, giving particulars as to date, place, your age at the time, the nature of the offence, the penalty, and all other facts relating thereto.

Have you ever been a dealer in intoxicating liquors, or a bartender? If so, when, where, for whom and for how long?

Do you ever drink distilled or fermented liquors of any kind? If so, state fully and definitely what your habits are in such use of them. If you are a total abstainer, state how long you have abstained.

In your opinion, what particular qualities should a good fireman possess?

Give your reasons for wishing to become a member of the fire force of Boston.

Third Subject:

1. Write in figures the following number: —
   Ten thousand sixteen dollars and three cents.
   Write in words the number expressed by the following figures: — 11,006.

2. Add the following column: — $2,743.14
   1,967.42
   3,742.87
   658.45
   1,592.18
   1,898.09

3. A man paid $2,750 for a farm, $125 for drainage and $87.75 for repairs; he then sold it for $3,150.50. What was his profit by the transaction? *Give the work in full.*

4. A five-dollar bill was given to pay for 16.4 pounds of cheese at $0.125 per pound. What change should the purchaser receive? *Give the work in full.*

5. How much coffee at 36 cents a pound can be bought for $39.72? *Give the work in full.*

6. What will 125 pounds of sugar cost at $6\frac{2}{5}$ cents a pound? *Give the work in full.*

Fourth Subject:

* Questions relating to the duties of a fireman, as prescribed by the fire commissioner.

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* **Each applicant for fire service will be examined upon the duties of the office for which he applies, and he is entitled to receive from the commissioners a pamphlet containing the necessary information, after filing his application.**

PHYSICAL EXAMINATION.

SCHEDULE B — CLASS 2.

I, [Write your full name.] , hereby declare that the answers to the following questions relating to my personal and family health, history, habits, and antecedents, are true to the best of my knowledge and belief, and that I am the person described in the following record of examination.

The Applicant will fill out this portion of the blank.

What is your occupation?
Do you use tobacco? If so, in what manner, and how much do you use in a week?
Do you drink intoxicating liquors? If so, how frequently?
Have you any disease now?
What diseases have you had during the last seven years?
Do you know of any hereditary disease in your family?
If your parents, brothers, or sisters, or any of them, are dead, of what disease did they die?
Have you ever had fits?
Have you ever had any fracture or dislocation?
Have you ever received any injury to the head or spine?
Are you subject to piles?
Have you been vaccinated?
Have you ever had rheumatism?

Certificate of Examining Surgeon.

Are there any indications of disease of the organs of respiration or their appendages?	
Are there any indications of disease of the heart or of the blood vessels?	
Is the sight good?	
Is the applicant color blind?	
Is the hearing good?	
Are the functions of the brain and nervous system in a healthy state?	
Has the applicant varicose veins?	
Has the applicant hernia?	
Is the applicant flat footed or has he any other malformation or disease of the feet?	

If the applicant has had any serious illness or injury, state expressly what effect, if any, is perceptible in the heart, lungs, kidneys or other abdominal organs, or the skin, eyes, ears, limbs, etc.	
Has the applicant any predisposition, either hereditary or acquired, to any constitutional disease, as phthisis, scrofula, rheumatism?	
* Does the applicant display any evidence of having or having had syphilis?	

* Syphilitic taint or obesity must be regarded as good cause for rejection.

Remarks.

I hereby certify that I have this day carefully and thoroughly examined the above-named applicant, and find that he is sound in limb and body, is able-bodied, of robust constitution, has good eyesight and good hearing, and in my opinion is physically qualified to sustain the labors and exposures, and perform the duties of a fireman in the city of Boston, and that the above is a truthful record of the examination.

Asst. City Physician.

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EXAMINATION IN DEVELOPMENT AND STRENGTH.

Applicant for Fireman of Boston.

	Measurement.	Per Cent.	Weight.	Product.
Age, weight,				
Height, ft. in.				
Sitting height, ft. in.				
Girth, waist, . A.			5	
B.			4	
C.			2	
Girth, chest, . A.			1	
B.			2	
Girth, chest full, C.			1	
D.			2	
Depth of chest, A.			1	
B.			2	
C.			3	
Depth of abdomen, A.			5	
B.			4	
C.			1	
Girth, R. thigh, . .			1	
Girth, L. thigh, . .			1	
Girth, R. calf, . . .			1	
Girth, L. calf, . . .			1	
Girth, R. upper arm,			1	
Girth, L. upper arm,			1	
Girth, R. forearm, .			1	
Girth, L. forearm, .			1	
Muscular condition,			4	
Development, ...				

The stature shall not be below 5 feet 5 inches, in bare feet, nor the weight below 135 pounds, naked.

All measurements shall be made on the bare body.

The examiner is called upon to pay special attention to the annexed schedules in determining the fitness of the applicant.

HEIGHT. Feet.	HEIGHT. Inches.	CIRCUMFERENCE OF CHEST. Inches.
5	5	32
5	6	32½
5	7	33
5	7½	33½
5	8	34
5	9	34½
5	10	35
5	11	35½
6	-	36
6	1	36½
6	2	37
6	3	37½
6	4	38

HEIGHT. Feet.	HEIGHT. Inches.	MIN. WEIGHT. Pounds.
5	5	135
5	6	135
5	7	135
5	7½	138
5	8	140
5	9	145
5	10	150
5	11	155
6	-	160
6	1	165
6	2	170
6	3	175
6	4	180

	Strength Tests.	Per Cent.	Weight.	Product.
Capacity of lungs, ...			3	
Strength of lungs, ...			2	
Strength of back, ...			3	
Strength of legs, ...			4	
Strength of upper arm, H. P. . .			5	
Strength of forearm, R. L. . .			3	
Pectorals, ...			1	
Traction pull, ...			3	
Dumb bells, ...			3	
Abdominal muscles, . . .			3	
Adductors, ...			1	
Ladder, ...			5	
Rope, ...			4	
Agility, ...			5	
			45	
Strength, ...				

	Per Cent.	Weight.	Product.
Development, . .		1	
Strength, . . .		2	
		3	
General physical condition, . . .			

Remarks.

I hereby certify that I have this day of , 190 , carefully and thoroughly examined the above-named applicant, and that the above is a truthful record of such examination.

Physical Examiner.

SCHEDULE B — CLASS 3.

Police of Cities other than Boston.

First Subject:

Copying a printed statement, thus showing handwriting and accuracy in copying.

Second Subject:

The answers to the questions on this sheet will be marked as a whole under two heads, — EXPERIENCE, and CLEARNESS AND CORRECTNESS OF STATEMENT. *Any false statement made by the applicant in answering these questions will be regarded as good cause for excluding him from the eligible list, or for removal or discharge during probation or thereafter.*

Write a letter to the mayor of the city, giving as complete an account as possible of your school experience; also of the occupations in which you have been engaged since you began to earn your own living, the firm or corporation by whom employed, and the length of time at each service.

Have you ever done police duty in any capacity, or been employed in any public office? If so, state when, where, how long, whether you were ever discharged for cause, or requested to resign; and whether, while in office, you were ever complained of for violation of the rules of the office, or for any conduct unbecoming an officer; and, if such complaint was made, what action was taken thereon.

Have you ever had any experience which, in your opinion, particularly fits you for the police service? If so, state the same fully.

When were you born? Give month, day and year.

Where were you born?

Have you ever served in the volunteer militia? If so, name the regiment and company, and state how long and in what capacity you served, and whether you have been honorably discharged, been dismissed, have resigned or been asked to resign.

Have you ever been convicted of any offence against the laws of this or any other State or nation? If so, make a full statement of the case, giving particulars as to date, place, your age at the time, the nature of the offence, the penalty, and all other facts relating thereto.

Have you ever been a dealer in intoxicating liquors, or a bartender? If so, when, where, for whom and for how long?

Do you ever drink distilled or fermented liquors of any kind? If so, state fully and definitely what your habits are in such use of them. If you are a total abstainer, state how long you have abstained.

In your opinion, what particular qualities should a good policeman possess?

Give your reasons for wishing to become a member of the police force.

Third Subject:

1. Write in figures the following number: —
   Twenty thousand six hundred five.
   Write in words the number expressed by the following figures: — 6,010
2. Add the following column: —
   $287.54
   195.87
   349.63
   101.25
   246.80
   328.42
3. If a man's yearly income is $1,200, and he spends $20 a week, how much can he save in one year? *Give the work in full.*
4. How many hogs can be bought for $1,076.25, if each hog cost $5.25? *Give the work in full.*
5. What will $8\frac{2}{3}$ pounds of tea cost at 66 cents a pound? *Give the work in full.*
6. How many quarts of milk, at 7 cents a quart, will pay for 35 pounds of sugar at 5 cents a pound? *Give the work in full.*

Fourth Subject:

* Questions relating to the duties of a police officer, definitions of crimes, descriptions of legal papers, statutory law, etc.

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* Each applicant for police service in any city will be examined upon definitions of crimes, descriptions of legal papers, and the duties of the office for which he applies, and he is entitled to receive from the Board of Examiners a pamphlet containing the necessary information, after filing his application.

PHYSICAL EXAMINATION.

SCHEDULE B — CLASS 3.

I, [Write your full name.] , hereby declare that the answers to the following questions relating to my personal and family health, history, habits and antecedents, are true to the best of my knowledge and belief, and that I am the person described in the following record of examination.

The Applicant will fill out this portion of the blank.

What is your occupation?
Do you use tobacco? If so, in what manner, and how much do you use in a week?
Do you drink intoxicating liquors? If so, how frequently?
Have you any disease now?
What diseases have you had during the last seven years?
Do you know of any hereditary disease in your family?
If your parents, brothers, or sisters, or any of them, are dead, of what disease did they die?
Have you ever had any fracture or dislocation?
Have you ever received any injury to the head or spine?
Are you subject to piles?
Have you been vaccinated?
Have you ever had rheumatism?

Certificate of Examining Surgeon.

* Circumference of chest after forced expiration, ; after full inspiration, .

Are there any indications of disease of the organs of respiration or their appendages?	
Are there any indications of disease of the heart or of the blood vessels?	
Is the sight good?	
Is the applicant color blind?	
Is the hearing good?	
Has the applicant varicose veins or varicocele?	
Has the applicant hernia?	
Is the applicant flat-footed or has he any other malformation or disease of the feet?	

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* There should be a difference of two inches at least at forced expiration and on full inspiration.

Has the applicant any predisposition, either hereditary or acquired, to any constitutional disease, as phthisis, scrofula, rheumatism?	
*** Does the applicant display any evidence of having or having had syphilis?**	

*** Syphilitic taint or obesity must be regarded as good cause for rejection.**

The applicant must be at least 5 feet 7 inches in height, in bare feet, and weigh at least 135 pounds, without clothing.

REMARKS.

I hereby certify that I have this day examined and find that he is, by actual test, feet inches in height, in bare feet, and weighs pounds without clothing, and that he is of a robust constitution, and, in my opinion, is physically qualified to perform the duties of a policeman in the city of

, *City Physician.*

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SCHEDULE B — CLASS 3.

District Police. — Inspection Department.

First Subject:

The answers to the questions on this sheet will be marked under two heads, — EXPERIENCE and CLEARNESS AND CORRECTNESS OF STATEMENT. *Any false statement made by the applicant in answering these questions will be regarded as good cause for excluding him from the eligible list, or for removal or discharge during probation or thereafter.*

What is your trade or occupation?

Where and under whom did you learn your trade or occupation?

At what kind of work are you now employed, who is your employer, and how long have you been so employed?

If you are not at work now, state where and by whom you were employed last, the kind of work, and why you left that work.

Have you followed more than one trade or occupation? If so, state what trades or occupations you have followed other than the one you have already mentioned.

If there is anything else in your experience which may tend to show your fitness for the position of Inspector in the District Police Force, state the same fully.

Have you ever been convicted of any offence against the laws of this or any other State or nation? If so, make a full statement of the case, giving particulars as to date, place, your age at the time, the nature of the offence, the penalty, and all other facts relating thereto.

Have you ever been a dealer in intoxicating liquors, or a bartender? If so, when, where, and for how long?

Do you ever drink distilled or fermented liquors of any kind? If so, state fully and definitely what your habits are in such use of them. If you are a total abstainer, state how long you have abstained.

Second Subject:

Copying printed matter, thus showing handwriting and accuracy in copying.

Third Subject:

1. Write in figures the following number: —
   Fifteen million four thousand fifty-one.
   Write in words the number expressed by the following figures: — 6,201,504
2. Add the following column of figures: —
   131,042
   275,634
   187,965
   98,325
   346,424
   764,326
3. Add together $2\frac{7}{15}$, $4\frac{5}{9}$, $3\frac{1}{6}$. *Give the work in full*, using the lowest common denominator. Give the answer in mixed numbers.
   Multiply $25\frac{2}{7}$ by $3\frac{1}{3}$. *Give the work in full.*
4. Add together 201.23, 36.5 and .693; divide the sum by 4, and subtract 18.59896 from the product. *Give the work in full.*
5. How many square yards are there in a plot of ground 165 feet long and 150 feet wide? *Give the work in full.*
6. How many cubic feet will there be in a tank 16 feet 3 inches long, 9 feet 6 inches wide and 6 feet deep? *Give the work in full.*

Fourth Subject:

Questions on the following subjects: Ventilation, sanitary plumbing, guarding machinery, safety devices on elevators, modes of egress in case of fire, devices and appliances for extinguishing fire, employment of women and children.

SCHEDULE B — CLASS 3.

Detective Force of District Police.

First Subject:

Write a letter, addressed to the Civil Service Commissioners, stating in detail what has been your experience. If you have had any practical experience in the duties of the office for which you apply, or of any similar office, state when, where, for how long and under whom you had it. *Sign the letter with your number, not your name.*

Second Subject:

1. Write in figures the following number: —
   Fifteen thousand seven hundred one.
   Write in words the number expressed by the following figures: — 10,010
2. Add the following column of figures: — 26,954
   17,683
   10,857
   18,642
   25,395
   32,963
3. If a man should buy a lot of land for $20,000, and sell it for $18,775, how much would he lose by the transaction? *Give the work in full.*
4. If 35 hogs cost $394.45, what is the cost of each hog? *Give the work in full.*
5. When eggs cost 35 cents a dozen, what is the cost of 648 eggs? *Give the work in full.*
6. What will 45 pounds of sugar cost at 8⅓ cents a pound? *Give the work in full.*

Third Subject:

Copying printed matter, thus showing handwriting and accuracy in copying.

Fourth Subject:

Questions relating to crimes, criminal processes, legal papers and methods of procedure which officers must know about in the prosecution of criminal cases.

PHYSICAL EXAMINATION.

SCHEDULE B — CLASS 3.

I, [Write your full name.] , hereby declare that the answers to the following questions relating to my personal and family health, history, habits, and antecedents, are true to the best of my knowledge and belief, and that I am the person described in the following record of examination.

The Applicant will fill out this portion of the blank.

What is your occupation?
Do you use tobacco? If so, in what manner, and how much do you use in a week?
Do you drink intoxicating liquors? If so, how frequently?
Have you any disease now?
What diseases have you had during the last seven years?
Do you know of any hereditary disease in your family?
If your parents, brothers, or sisters, or any of them are dead, of what disease did they die?
Have you ever had any fracture or dislocation?
Have you ever received any injury to the head or spine?
Are you subject to piles?
Have you been vaccinated?
Have you ever had rheumatism?

Certificate of Examining Surgeon.

* Circumference of chest after forced expiration, ; after full inspiration,	
Are there any indications of disease of the organs of respiration or their appendages?	
Are there any indications of disease of the heart or of the blood vessels?	
Is the sight good?	
Is the applicant color blind?	
Is the hearing good?	
Has the applicant varicose veins or varicocele?	
Has the applicant hernia?	
Is the applicant flat footed or has he any other malformation or disease of the feet?	
Has the applicant any predisposition, either hereditary or acquired, to any constitutional disease, as phthisis, scrofula, rheumatism?	
† Does the applicant display any evidence of having or having had syphilis?	

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* There should be a difference of two inches at least at forced expiration and on full inspiration.

† Syphilitic taint or obesity must be regarded as good cause for rejection.

The applicant must be at least 5 feet 7 inches in height, in bare feet, and weigh at least 135 pounds, without clothing.

REMARKS.

I hereby certify that I have this day examined and find that he is, by actual test, feet inches in height, in bare feet, and weighs pounds without clothing, and that he is of a robust constitution, and, in my opinion, is physically qualified to perform the duties of a district police officer.

Medical Examiner,
District.
190 . County.

SCHEDULE B — CLASS 4.

Police Force of Boston.

First Subject:

Copying a printed statement, thus showing handwriting and accuracy in copying.

Second Subject:

The answers to the questions on this sheet will be marked as a whole under two heads, — EXPERIENCE and CLEARNESS AND CORRECTNESS OF STATEMENT. *Any false statement made by the applicant in answering these questions will be regarded as good cause for excluding him from the eligible list, or for removal or discharge during probation or thereafter.*

Write a letter to the mayor of Boston, giving as complete an account as possible of your school experience; also of the various occupations in which you have been engaged since you began to earn your own living, the firm or corporation by whom employed, and the length of time at each service.

Have you ever done police duty in any capacity, or been employed in any public office? If so, state when, where, how long, whether you were ever discharged for cause, or requested to resign; and whether, while in office, you were ever complained of for violation of the rules of the office, or for any conduct unbecoming an officer; and, if such complaint was made, what action was taken thereon.

Have you ever had any experience which, in your opinion, particularly fits you for the police service? If so, state the same fully.

When were you born? Give month, day and year.

Where were you born?

Have you ever served in the volunteer militia? If so, name the regiment and company, and state how long and in what capacity you served, and whether you have been honorably discharged, been dismissed, have resigned or been asked to resign.

Have you ever been convicted of any offence against the laws of this or any other State or nation? If so, make a full statement of the case, giving particulars as to date, place, your age at the time, the nature of the offence, the penalty and all other facts relating thereto.

Have you ever been a dealer in intoxicating liquors, or a bartender? If so, when, where, for whom and for how long?

Do you ever drink distilled or fermented liquors of any kind? If so, state fully and definitely what your habits are in such use of them. If you are a total abstainer, state how long you have abstained.

In your opinion, what particular qualities should a good policeman possess?

Give your reasons for wishing to become a member of the police force of Boston.

Third Subject:

1. Write in figures the following amount: —
   Ten thousand five dollars and two cents.
   Write in words the number expressed by the following figures: — 9,002

2. Add the following column: —

```
$1,865.43
 3,459.12
 1,865.42
   999.85
 2,394.12
 1,164.10
```

3. A man paid $4,162.50 for a farm, $137.50 for drainage and $250.75 for repairs; he then sold it for $4,850.50. What was his profit by the transaction? *Give the work in full.*

4. A ten-dollar bill was given to pay for 18.4 pounds of coffee at $0.325 per pound. What change should the purchaser receive? *Give the work in full.*

5. How much coffee at 39 cents a pound can be bought for $27.56? *Give the work in full.*

6. What will 220 pounds of sugar cost at $7\frac{2}{5}$ cents a pound? *Give the work in full.*

Fourth Subject:

[*] Questions relating to the duties of a policeman, as prescribed by the Board of Police.

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[*] Each applicant for police service will be examined upon definitions of crimes, descriptions of legal papers, and the duties of the office for which he applies, and he is entitled to receive from the commissioners a pamphlet containing the necessary information, after filing his application.

PHYSICAL EXAMINATION.

SCHEDULE B — CLASS 4.

I, [Write your full name.] , hereby declare that the answers to the following questions relating to my personal and family health, history, habits, and antecedents, are true to the best of my knowledge and belief, and that I am the person described in the following record of examination.

The Applicant will fill out this portion of the blank.

What is your occupation?
Do you use tobacco? If so, in what manner, and how much do you use in a week?
Do you drink intoxicating liquors? If so, how frequently?
Have you any disease now?
What diseases have you had during the last seven years?
Do you know of any hereditary disease in your family?
If your parents, brothers, or sisters, or any of them, are dead, of what disease did they die?
Have you ever had fits?
Have you ever had any fracture or dislocation?
Have you ever received any injury to the head or spine?
Are you subject to piles?
Have you been vaccinated?
Have you ever had rheumatism?

Certificate of Examining Surgeon.

Are there any indications of disease of the organs of respiration or their appendages?	
Are there any indications of disease of the heart or of the blood vessels?	
Is the sight good?	
Is the applicant color blind?	
Is the hearing good?	
Are the functions of the brain and nervous system in a healthy state?	
Has the applicant varicose veins?	
Has the applicant hernia?	
Is the applicant flat footed or has he any other malformation or disease of the feet?	

If the applicant has had any serious illness or injury, state expressly what effect, if any, is perceptible in the heart, lungs, kidneys or other abdominal organs, or the skin, eyes, ears, limbs, etc.	
Has the applicant any predisposition, either hereditary or acquired, to any constitutional disease, as phthisis, scrofula, rheumatism?	
* Does the applicant display any evidence of having or having had syphilis?	

* Syphilitic taint or obesity must be regarded as good cause for rejection.

Remarks.

I hereby certify that I have this day carefully and thoroughly examined the above-named applicant, and find that he is sound in limb and body, is able-bodied, of robust constitution, has good eyesight and good hearing, and in my opinion is physically qualified to sustain the labors and exposures, and perform the duties of a policeman in the city of Boston, and that the above is a truthful record of the examination.

Asst. City Physician.

. 190 .

EXAMINATION IN DEVELOPMENT AND STRENGTH.

Applicant for Policeman of Boston.

	Measurement.	Per Cent.	Weight.	Product.
Age, weight,				
Height, ft. in.				
Sitting height, ft. in.				
Girth, waist, A.			5	
B.			4	
C.			2	
Girth, chest, A.			1	
B.			2	
Girth, chest full, C.			1	
D.			2	
Depth of chest, A.			1	
B.			2	
C.			3	
Depth of abdomen, A.			5	
B.			4	
C.			1	
Girth, R. thigh, . .			1	
Girth, L. thigh, . .			1	
Girth, R. calf . . .			1	
Girth, L. calf, . . .			1	
Girth, R. upper arm,			1	
Girth, L. upper arm,			1	
Girth, R. forearm, .			1	
Girth, L. forearm, .			1	
Muscular condition,			4	
Development, ...				

The stature shall not be below 5 feet 8 inches, in bare feet, nor the weight below 140 pounds, naked.

All measurements shall be made on the bare body.

The examiner is called upon to pay special attention to the annexed schedules in determining the fitness of the applicant.

HEIGHT. Feet.	HEIGHT. Inches.	CIRCUMFERENCE OF CHEST. Inches.	HEIGHT. Feet.	HEIGHT. Inches.	WEIGHT. Pounds.
5	8	34	5	8	140
5	9	34½	5	9	145
5	10	35	5	10	150
5	11	35½	5	11	155
6	–	36	6	–	160
6	1	36½	6	1	165
6	2	37	6	2	170
6	3	37½	6	3	175
6	4	38	6	4	180

	Strength Tests.	Per Cent.	Weight.	Product.
Capacity of lungs, ...			3	
Strength of lungs, ...			2	
Strength of back, ...			3	
Strength of legs, ...			4	
Strength of upper arm, H. P. . .			5	
Strength of forearm, R. L. . .			3	
Pectorals, ...			1	
Traction pull, ...			3	
Dumb bells, ...			3	
Abdominal muscles, ...			3	
Adductors, ...			1	
Agility, ...			4	
			35	
Strength, ...				

	Per Cent.	Weight.	Product.
Development, . .		1	
Strength, . . .		2	
		3	
General physical condition, . . .			

Remarks.

I hereby certify that I have this day of , 190 , carefully and thoroughly examined the above-named applicant, and that the above is a truthful record of such examination.

Physical Examiner.

Schedule B — Class 5.

Draw-tender of Bridges.

First Subject:

The answers to the questions on this sheet will be marked under the head Experience. *Any false statement made by the applicant in answering these questions will be regarded as good cause for excluding him from the eligible list, or for removal or discharge during probation or thereafter.*

What is your trade or occupation?

Where and under whom did you learn your trade or occupation?

How long have you followed that trade or occupation?

At what kind of work are you now employed, who is your employer, and how long have you been so employed?

If you are not at work now, state where and by whom you were employed last, the kind of work, and why you left that work.

Have you followed more than one trade or occupation? If so, state what trades or occupations you have followed other than the one you have already mentioned.

Have you ever been a draw-tender or assistant draw-tender? If so, state when, where, for how long, and, if you have left the position, why you left it.

Have you ever had charge of men? If so, state fully how many, where, when, for how long and in what kind of work.

Have you had any other experience which, in your opinion, fits you for the position you seek? If so, state the same fully.

Can you pull and manage a row-boat?

Are you an expert swimmer?

Do you hold a State license as an engineer? If so, what is the date of it?

Have you ever been convicted of any offence against the laws of this or any other State or nation? If so, make a full statement of the case, giving particulars as to date, place, your age at the time, the nature of the offence, the penalty, and all other facts relating thereto.

Have you ever been a dealer in intoxicating liquors, or a bartender? If so, when, where and for how long?

Do you ever drink distilled or fermented liquors of any kind? If so, state fully and definitely what your habits are in such use of them. If you are a total abstainer, state how long you have abstained.

What is the date of your birth?

Where were you born?

Second Subject:

1. Write in figures the following number: —
   One thousand five hundred and sixty-three dollars and fourteen cents.
2. Write in words the number expressed by the following figures: — 14,368
3. Add the following column of figures: —
   1,792
   3,467
   1,823
   3,119
   427
   2,236
4. From 21,315 subtract 19,678. *Give the work in full.*
5. Divide 4,968 by 23. *Give the work in full.*
6. Multiply 726 by 54. *Give the work in full.*

Third Subject:

Questions relating to the duties which draw-tenders are called upon to perform.

SCHEDULE B — CLASSES 6 AND 7.

Foremen and Inspectors.

First Subject:

The answers to the questions on this sheet will be marked under the head EXPERIENCE. *Any false statement made by the applicant in answering these questions will be regarded as good cause for excluding him from the eligible list, or for removal or discharge during probation or thereafter.*

What is your trade or occupation?

Where and under whom did you learn your trade or occupation?

At what kind of work are you now employed, who is your employer, and how long have you been so employed?

If you are not at work now, state where, how long and by whom you were employed last, the kind of work, and why you left that work.

Have you followed more than one trade or occupation? If so, state what trades or occupations you have followed other than the one you have already mentioned, and how long you worked at each.

If there is anything else in your experience which may tend to show your fitness for the position you seek, state the same fully.

Have you ever had charge of men? If so, state fully how many, where, when, for how long and in what kind of work.

Have you ever been foreman or sub-foreman in charge? If so, state when, where, how long and for whom you worked, and the kind of work.

Have you ever been convicted of any offence against the laws of this or any other State or nation? If so, make a full statement of the case, giving particulars as to date, place, your age at the time, the nature of the offence, the penalty, and all other facts relating thereto.

Have you ever been a dealer in intoxicating liquors, or a bartender? If so, when, where and for how long?

Do you ever drink distilled or fermented liquors of any kind? If so, state fully and definitely what your habits are in such use of them. If you are a total abstainer, state how long you have abstained.

Second Subject:

1. Write in figures the following number: —
   One thousand five hundred sixty-three.
   Write in words the number expressed by the following figures: — 12,207
2. Add the following column of figures: — 1,743
   876
   1,427
   3,764
   998
   2,507
3. Suppose you have under you 36 men at $1.75 per day; a rain-storm prevents them from working the last half day. What will be the amount of their pay for that day? *Give the work in full.*
4. If you have a pile of 10,000 bricks, and take away 7,550 of them, how many will be left? *Give the work in full.*
5. When stone is worth 88 cents a yard, how many yards can be bought for $37.85? *Give the work in full.*

Third Subject:

Foremen and inspectors in the water department.

Questions on trench work, pipe-laying, measurements and materials.

Third Subject:

Foremen and inspectors in sewer department.

Questions relating to the different kinds of sewers, the preparation and use of cement and other materials, and trench work.

Third Subject:

Foremen and inspectors in the department of streets, parks, cemeteries and public grounds.

Questions on street, road and sidewalk building, cart measurement, grade-stakes, etc.

Third Subject:

Foremen and inspectors in the street cleaning division.

Questions relating to cleaning streets.

Third Subject:

Foremen and inspectors in sanitary division.

Questions relating to the handling of ashes, offal, etc.

Fourth Subject:

Foremen and inspectors in all the departments except the street cleaning and sanitary departments.

Questions on ledge work, and the care and use of explosives.

Fourth Subject:

Foremen and inspectors in the street cleaning and sanitary divisions.

Questions relating to the handling and care of horses.

Fifth Subject:

Foremen and inspectors in the department of streets, parks, cemeteries and public grounds.

Questions on drainage.

SCHEDULE B — CLASS 6.

Sub-foreman of Laborers.

First Subject:

State your occupation during the past ten years, the names and residences, so far as you remember, of your employers during that period.

Have you ever been foreman or sub-foreman in charge? If so, state when, where, and under whom you worked, and the kind of work in which you were employed.

Have you ever had charge of men? If so, state fully how many, where, when, for how long and in what kind of work.

Have you ever done any ledge work, or had the handling or care of explosives? If so, state when, where and for how long.

[On these statements the applicant is marked for experience only.]

Second Subject:

1. Write in figures the following: —
   One hundred and sixty-three dollars and twelve cents.
2. If you receive 23 loads of gravel one day, 34 loads the next, and 17 loads the next, how many loads will you then have in all? *Give the work in full.*
3. If you have $45 and pay out $27 for rent and other expenses, how much will you have left? *Give the work in full.*
4. If a cubic yard of stone costs 88 cents, how many yards can be bought for $39.60? *Give the work in full.*
5. What wages, at $1.75 per day, would be due a laborer, he having worked an entire week of six days, except one half day. *Give the work in full.*

Third Subject:

Questions relating to general work; the use of tools, reading grade-stakes, tallying, etc.

Fourth Subject: (Not obligatory.)

Questions on ledge work; the tools used, care and use of explosives, etc.

Fourth Subject:

Sub-foremen in the sanitary and street cleaning divisions.

Questions relating to the handling and care of horses.

Schedule B — Class 7.

Building Inspectors.

First Subject:

The answers to the questions on this sheet will be marked under two heads, — Experience, and Clearness and Correctness of Statement. *Any false statements made by the applicant in answering these questions will be regarded as good cause for excluding him from the eligible list, or for removal or discharge during probation or thereafter.*

What is your trade or occupation?

Where and under whom did you learn your trade or occupation?

At what kind of work are you now employed, who is your employer, and how long have you been so employed?

If you are not at work now, state where and by whom you were employed last, the kind of work, and why you left that work.

Did your present or last employer sign a recommendation for you upon your present application? If not, why not?

Have you followed more than one trade or occupation? If so, state what trades or occupations you have followed other than the one you have already mentioned.

If there is anything else in your experience which may tend to show your fitness for the position of Building Inspector, state the same fully.

Have you ever been convicted of any offence against the laws of this or any other State or nation? If so, make a full statement of the case, giving particulars as to date, place, your age at the time, the nature of the offence, the penalty, and all other facts relating thereto.

Have you ever been a dealer in intoxicating liquors, or a bartender? If so, when, where, and for how long?

Do you ever drink distilled or fermented liquors of any kind? If so, state fully and definitely what your habits are in such use of them. If you are a total abstainer, state how long you have abstained.

Second Subject:

Copying printed matter, thus showing handwriting and accuracy in copying.

Third Subject:

Arithmetic.

Fourth Subject:

Questions relating to brick and stone masonry, carpentry and iron work.

Fifth Subject:

Knowledge of construction as shown by drawing plans to scale.

SCHEDULE B — CLASS 8.

Engineers, Janitors and Persons having Charge of Steam Boilers and Furnaces in the School Buildings in the City of Boston.

First Subject:

The answers to the questions on this sheet will be marked under the head EXPERIENCE. *Any false statement made by the applicant in answering these questions will be regarded as good cause for excluding him from the eligible list, or for removal or discharge during probation or thereafter.*

What is your trade or occupation?

Where and under whom did you learn your trade or occupation?

At what kind of work are you now employed, who is your employer, and how long have you been so employed?

If you are not at work now, state where and by whom you were employed last, the kind of work, and why you left that work.

Have you followed more than one trade or occupation? If so, state what trades or occupations you have followed other than the one you have already mentioned.

If there is anything else in your experience which may tend to show your fitness for the position you seek, state the same fully.

When were you born?

Where were you born?

Have you ever had the charge or care of any building, public or private? If so, state the kind of building, its size, where located, and how long you had the charge or care of it.

Have you had any experience in taking care of furnaces or heating apparatus? If so, state when and where, the kind of building heated, how long you were so employed, and what kind of heating apparatus was used.

Do you now hold a State license as an engineer or fireman? If so, give class and date of license.

Have you ever been convicted of any offence against the laws of this or any other State or nation? If so, make a full statement of the case, giving particulars as to date, place, your age at the time, the nature of the offence, the penalty, and all other facts relating thereto.

Have you ever been a dealer in intoxicating liquors, or a bartender? If so, when, where, and for how long?

Do you ever drink distilled or fermented liquors of any kind? If so, state fully and definitely what your habits are in such use of them. If you are a total abstainer, state how long you have abstained.

Second Subject:

Arithmetic: Six questions, including addition, subtraction, multiplication, division, and the reading and writing of numbers.

Third Subject:

Copying a printed statement, thus showing handwriting and accuracy in copying.

Fourth Subject:

Questions relating to the care and handling of furnaces, gas, water supply, etc., ventilation and sanitary matters.

[Each applicant for appointment to a position as engineer is required to exhibit a license from a State Inspector of Steam Boilers.]

[Each applicant for appointment to a position as janitor of a school building where steam heat is used will be required to exhibit a license from a State Inspector of Steam Boilers.]

SCHEDULE B — CLASS 9.

The Fire Service of Cities other than Boston.

This examination is similar to that of Schedule B, Class 2, — the fire service of Boston.

SCHEDULE B — CLASS 10.

Truant Officers of Boston.

First Subject:

Copying printed statement.

Spelling.

Second Subject:

The answers to the questions on this sheet will be marked as a whole under two heads, — EXPERIENCE and CLEARNESS AND CORRECTNESS OF STATEMENT. *Any false statement made by the applicant in answering these questions will be regarded as good cause for excluding him from the eligible list, or for removal or discharge during probation or thereafter.*

State how long you have resided in this city, and what your occupation has been since you began to earn your living.

If you have had any practical experience in the duties of the office for which you apply, or of any similar office, state when, where, for how long and under whom you had it.

State also any experience you have had in the superintendence of others, either in public or private business.

If you are familiar with any foreign language, state what language it is, and whether you can read, write and speak it.

Write not less than ten lines. Do not sign your name.

Have you ever been employed as a public officer? If so, state what office you held, when, where, how long you served, whether you were ever discharged for cause, or requested to resign; and whether, while in office, you were ever complained of for violation of the rules of the office, or for any conduct unbecoming an officer; and, if such complaint was made, what action was taken thereon.

Where were you born? Give month, day and year.

Have you ever served in the army or navy of the United States, either in time of peace or war? If so, how long did you serve and in what capacity, and did you receive an honorable discharge therefrom?

Have you ever served in the volunteer militia? If so, name the regiment and company, and state how long and in what capacity you served, and whether you have been honorably discharged, been dismissed, have resigned or been asked to resign.

Have you ever had the handling of men, either in public office or private employment? If so, state how many and in what kind of work.

Have you ever been convicted of any offence against the laws of this or any other State or nation? If so, make a full statement of the case, giving particulars as to date, place, your age at the time, the nature of the offence, the penalty, and all other facts relating thereto.

Have you ever been a dealer in intoxicating liquors, or a bartender? If so, when, where, and for how long?

Do you ever drink distilled or fermented liquors of any kind? If so, state fully and definitely what your habits are in such use of them. If you are a total abstainer, state how long you have abstained.

What particular qualities should a man possess in order that he may become an efficient truant officer?

Third Subject:

Arithmetic, including addition, subtraction, multiplication and common fractions.

Fourth Subject:

Letter writing.

Note. Applicants for positions as truant officers are also required to undergo a physical examination.

Schedule B — Class 11.

Janitors of School Buildings in Cities other than Boston.

An examination similar to that given for Schedule B, Class 8.

Schedule B — Class 13.

Divisions of the Civil Engineering Force.

Division A, or rodmen: To include chainmen, rodmen and all assistants under whatever designation, except draughtsmen, whose maximum pay does not exceed the rate of $800 per annum.

Division B, or instrument men: To include transitmen, levellers and all assistants under whatever designation, except those covered by divisions A and E, and whose maximum pay does not exceed the rate of $1,100 per annum.

Division C, or assistant engineers (junior grade): To include engineers and surveyors in responsible charge of work and engineers in charge of designing, whose maximum pay does not exceed the rate of $1,600 per annum.

Division D, or assistant engineers: To include all engineers whose pay exceeds the rate of $1,600 per annum.

Division E, or draughtsmen: To include all assistants whose duties are chiefly drafting, and whose pay does not exceed the rate of $1,300 per annum.

SCHEDULE B, CLASS 13, DIVISION A (RODMAN).

Handwriting; shown by copying printed matter.

Spelling; twenty words, announced by one of the examiners.

Education and experience.

The answers to the questions on this sheet will be marked under the heads of EDUCATION and EXPERIENCE. *Any false statement made by the applicant in answering these questions will be regarded as good cause for excluding him from the eligible list, or for removal or discharge during probation or thereafter.*

What is the date of your birth?

State what grammar school, high school, technical school or college you have attended, the dates and length of attendance, the studies pursued and diplomas taken. State any other facts regarding your education which you think may be of service to the examiners.

Have you had any practical experience in the duties of the position for which you apply? If you have, state the particular position or positions you have held; the nature of your duties in each case; where, when, how long and under whom (giving accurately the name and address) you have been so employed.

Are you employed at present? If you are, give the name and address of your employer, state the nature of your duties and the length of time you have held this position. If you are not employed, state how long you have been without employment and the cause for which you last ceased work.

Arithmetic, — including common and decimal fractions, percentage, square root, mensuration of rectangular surfaces and solids.

Sample Questions.

1. Add 467 feet $8\frac{1}{2}$ inches, 27 feet $9\frac{7}{8}$ inches, 510 feet $4\frac{1}{8}$ inches and 102 feet $6\frac{5}{8}$ inches, and from the sum subtract 299.52 feet, giving the answer to the nearest eighth of an inch.
2. Multiply two hundred fifty-seven ten-thousandths by forty-nine thousandths.
3. Divide 2,880 by .0036.
4. Add $\frac{10}{11}$, $\frac{123}{125}$ and $\frac{53}{85}$, and reduce the sum to a decimal fraction carried to five places of decimals.
5. A dry brick weighing 4 pounds 6 ounces was immersed in water for twenty-four hours, at the end of which time it was found to weigh 5 pounds $0\frac{1}{2}$ ounce; what per cent. of its own weight was absorbed?
6. A square plot of ground contains 108,900 square feet; what is the length of a side?
7. A rectangular piece of land, 210 feet 3 inches long and 50 feet 9 inches wide, has a ditch 6 feet wide and 4 feet deep, which was dug inside the boundary lines, said lines being the outer edge of the ditch. How many cubic yards of material were removed from the ditch?

Algebra; to and including the solution of simultaneous equations of the second degree.

Sample Questions.

1. Multiply $\left(x^2-\frac{x}{3}+\frac{1}{4}\right)$ by $\left(\frac{x}{2}+\frac{1}{4}\right)$.
2. Divide $256\,a^3\,b\,c^2\,x^3$ by $-16\,a^2\,c\,x^2$.
3. Divide a distance of 1,000 feet into three parts, — A, B and C, such that A shall be 72 feet longer than B and 100 feet shorter than C. Solve by algebraic method.
4. Solve the equation $2\sqrt{x}+\frac{2}{\sqrt{x}}=5$.
5. A rectangular field contains 40,960 square feet. If its length were increased by 65 feet and its breadth by 50 feet, its area would be increased by 26,450 square feet. Find the length and breadth of the field.

Geometry; the applicant will be expected to have such familiarity with the principal theorems of plane and solid geometry as will enable him to solve simple problems dealing with lines, angles, areas and volumes. *Demonstrations of theorems will not be required.*

Sample Questions.

1. One interior angle of a certain triangle contains 43° 19′ 40″; a second interior angle contains 105° 59′ 20″; what is the value of the remaining angle?
2. Choose any three points on paper, and by aid of a sketch explain how, by geometrical construction, you would find the centre of a circle passing through them.
3. What is the length of the circumference of a circle which would enclose an area of 5,000 square feet? $\pi = 3.1416$.
4. If a field have two parallel sides, one of them 356 feet long and the other 407 feet long, the perpendicular distance between them being 96.5 feet, what is the area of the field?
5. A stone in the form of a pyramid 3 feet high, with its base a square 30 inches on a side, will weigh how much, assuming 150 pounds weight to the cubic foot?

Duties. Questions relating to the construction and use of rods, tapes, verniers and other implements and devices. Details of the work of rodmen in the field and office. Definitions of technical terms.

Tracing. Tracing cloth and a plan or a drawing of some engineering structure are furnished the applicant, who will be required to make a tracing in India ink.

SCHEDULE B, CLASS 13, DIVISION B (INSTRUMENT MAN).

$$\left.\begin{array}{l}\text{Handwriting.}\\ \text{Spelling.}\\ \text{Education and experience.}\end{array}\right\}\text{Same as Division A.}$$

Algebra. To and including the solution of simultaneous equations of the second degree.

Sample Questions.

1. Simplify, as far as possible, the expression $\dfrac{x - 1 - \dfrac{12}{x+3}}{x - 5 + \dfrac{12}{x+3}}$
2. Solve the equation $\left(\frac{a}{b} + \frac{b}{a}\right) x \div \left(\frac{a}{b} - \frac{b}{a}\right) + 2x = a$.
3. The circumference of the hind-wheel of a carriage is greater by 4 feet than that of the fore-wheel. In travelling 1,200 yards, the fore-wheel makes 75 revolutions more than the hind-wheel. Find the circumference of each wheel.

4. A man has two square lots of unequal size, together containing 15,025 square feet. If the lots were contiguous, it would require 530 feet of fence to embrace them in a single enclosure of six sides. Find the area of each lot.
5. Solve, for either x or y, the simultaneous equations $\begin{cases} x^2 + 3y^2 = 28 \\ x^2 + 2y^2 + xy = 16 \end{cases}$

Geometry. The applicant will be expected to have such familiarity with the principal theorems of plane and solid geometry as will enable him to solve simple problems dealing with lines, angles, areas and volumes. *Demonstrations of theorems will not be required.*

Sample Questions.

1. The altitudes of two equilateral triangles are respectively as 3 to 4. Find the ratio of their areas, and give your reasoning.
2. Show how, by geometrical construction, you would divide a given straight line into any required number of equal parts. Give the reasoning upon which you base your construction.
3. Find the length of the perimeter of an equilateral triangle which would enclose one acre.
4. A metal cylinder 5 feet long and 8 inches in diameter is turned down in a lathe to a diameter of 6 inches. Find the total weight of metal removed, assuming 450 pounds per cubic foot.
5. A cone measures 32 feet around the base, and the length of its slope is 8 feet. Find the number of cubic yards it contains.

Trigonometry. Plane trigonometry, — trigonometrical functions, properties of logarithms and use of logarithmic table, solution of triangles, either right or oblique, by either natural functions or logarithms.

Sample Questions.

1. What do you understand by the cosine of an angle? By the tangent? By the versed sine? The sine of a certain angle is $\frac{1}{3}$; compute its cosine. What is the cosine of 135°?
2. What do you understand by the base of a system of logarithms? What is the base of the common system? In the common system, what is the logarithm of 1? Of 1,000? Of 0.01?
3. Compute by logarithms:

$$\frac{3.7096 \times 286.51 \times 0.2956}{1633.72}; \ (23.8464)^3; \ \sqrt[3]{0.0042937}.$$

4. In a right-angled triangle the hypothenuse measures 154 feet, and one of the acute angles 49° 53′. Compute, by natural functions, the lengths of the sides; determine also the area of the triangle.
5. In an oblique triangle, the angle B measures 19° 21′ 40″, the angle A 103° 35′, and the side opposite B 87.36 feet. Compute, by logarithms, one of the remaining sides.

Duties. Questions relating to the details of the work of the second man in a surveying party, in the field and office, including the construction, adjustment, care and use of the transit and level; compass and stadia surveying; details of surveying and levelling, keeping field notes, measuring and computing earth work. Definition of technical terms.

Plotting. Plotting a survey by co-ordinates from field notes, inking-in plot and lettering a title.

Sample Question.

Plot accurately, on a scale of 20 feet to an inch, the survey of a lot of land given in the following notes: —

Station.	Bearing.	Distance.
1.	N. 35° 0′ E.	108.00 feet.
2.	N. 83° 30′ E.	51.60 "
3.	S. 57° 0′ E.	88.80 "
4.	S. 34° 15′ W.	142.00 "
5.	N. 56° 30′ W.	129.20 "

Ink-in the plot, mark the bearing and length of each side, and letter the following title, making your own arrangement: "Plan of land belonging to John Smith, December, 1897. Scale, 20 feet to an inch." (Arrange and space all letters, and finish enough in each line to show your skill.)

SCHEDULE B, CLASS 13, DIVISION C (ASSISTANT ENGINEER, JUNIOR GRADE).

Education and experience. Same as Division A.

Algebra. To and including the solution of simultaneous equations of the second degree.

Sample Questions.

1. Find, in as simple form as possible, the value of

$$\left(\frac{2}{3y^2}-\frac{2}{xy}+\frac{3}{2x^2}\right)\div\left(\frac{2}{3y^2}-\frac{3}{2x^2}\right)$$

2. Increase the length of a given rectangle 2 feet, and its width 1 foot, and its area is increased 12 square feet. On the other hand, diminish its length 3 feet, and its width 2 feet, and its area is diminished 11 square feet. What is the perimeter of the rectangle?
3. Francis' formula for the discharge over suppressed weirs is $Q = 3.33\, l\, h^{\frac{3}{2}}$, in which, if l and h are in feet, Q is in cubic feet per second. If h be 0.324 foot, what value of l will correspond to 5.37 cubic feet per second for Q?
4. A boat's crew rowed down stream 7 miles and back in 3 hours 20 minutes. The velocity of the current was 2 miles per hour. How many miles per hour would the crew make in still water?
5. Two loans, together amounting to $45,000, are made at different rates of interest, but the amounts borrowed are such that the respective annual interest payments are equal. If the first loan were to be charged the second's rate of interest, its annual payment would be $800; and if the second loan were to be charged the first's rate of interest, its annual payment would be $1,250. Find the respective rates of interest.

Geometry. The applicant will be expected to have such familiarity with the principal theorems of plane and solid geometry as will enable him to solve simple problems dealing with lines, angles, areas and volumes. *Demonstrations of theorems will not be required.*

Sample Questions.

1. Explain, by reference to a sketch, how you would divide a line that is 26 inches long into three parts proportional to the numbers 2, $\frac{3}{4}$, $\frac{1}{2}$. Compute also the lengths of the respective parts.
2. A hexagonal bar of steel, 10 feet 3 inches long, measures 12 inches around the perimeter of a right section. What is the weight of the bar, at 490 pounds per cubic foot?
3. A trapezoidal lot of land, 120 feet in length, measured perpendicularly between its parallel ends, tapers uniformly and equally on both sides from a width of 24 feet at one end to 14 feet at the other end. Where should it be cut transversely, that is, parallel to the ends, so as to make two pieces of equal area?
4. The base of a pyramid contains 144 square feet. A plane parallel to the base and four feet from the vertex cuts a section containing 64 square feet. What is the height of the pyramid?

5. A hollow cylinder 4 feet in diameter and 15 feet long, lying upon its side, is filled with water until the latter touches two-thirds of the circumference, at which time it is also within 1 foot of the top. How much water does the cylinder then contain?

Trigonometry. Plane trigonometry, — trigonometrical functions, properties of logarithms and use of logarithmic table, solution of triangles, either right or oblique, by either natural functions or logarithms.

Sample Questions.

1. The value of the sine of a certain angle is $\frac{12}{13}$. Without using tables, find the value of cosine, tangent, cotangent, secant and cosecant, and show clearly your method.
2. Three times the sine of a certain angle is equal to twice the square of the cosine of the same angle. What is the angle?
3. By logarithms obtain the value of the following expression: —

$$\frac{\left(0.68291\right)^{\frac{5}{2}} \times \sqrt{5.9546} \times \sqrt[3]{61.2}}{\sqrt[5]{298.543}}$$

4. Two tangents to a circular curve of 3,000 feet radius intersect so as to include an interior angle of 157° 8′. Find the length of either tangent from point of contact with curve to point of intersection, using natural functions.
5. A distance *A B* across a stream is to be determined. A base line *A C*, 200 feet long, is measured off on one bank, sights are taken from each end of it to *B*, and the angles which the lines of sight make with the base are measured, *A* being 104° 53′ and *C* 58° 11′. Compute the distance *A B*, using logarithms.

Duties. Questions relating to the work of the head of an engineering field party, including the special work of surveying in cities, giving lines and grades for construction, measuring and estimating earth, rock and quantities in engineering structures; definition of technical terms; surveying problems.

Engineering theory. Elementary principles of mechanics, hydrostatics and hydraulics, and their application to simple problems. Problems in surveying.

Sample Questions.

(*Applicants are required to answer but three questions.*)

1. The notes of a survey and the calculated latitudes and departures are as follows: —

Stations.	Bearings.	Distances.	Latitudes.	Departures.
1.	N. 30° 0′ E.	328.68	284.64	164.34
2.	N. 57° 45′ E.	306.90	163.78	259.54
3.	S. 39° 30′ E.	396.00	305.58	251.87
4.	S. 37° 15′ W.	391.38	311.53	236.92
5.	N. 69° 15′ W.	465.96	165.07	435.78

Balance the survey, give the error of closure and calculate the area.

2. Two streets intersect at an angle of 42° 28′. It is desired to ease the acute-angled intersection, making the street boundary a circular curve of ten feet radius, tangent to the street lines. Give the area of the land to be taken, and the length of each line bounding it.

3. What should be the cross-section of a yellow pine beam 12 feet long, supported at both ends, to sustain with safety a centre load of 5,000 pounds?

   What should be the cross-section if the load is uniformly distributed?

   If a beam of the same length is fixed at one end only, and has the same load concentrated at the other, what should be the cross-section?

   Assume for all cases an extreme fibre strain of 1,250 pounds per square inch. The moment of inertia of a rectangle is $\frac{bh^3}{12}$.

4. Compute the number of square yards of paving in the road bed of a section of a curved street 30 feet wide, the radius of the centre line being 175 feet and the angle at the centre being 47 degrees.

5. A rectangular wall 10 feet high, weighing 140 pounds per cubic foot, would need to be how thick in order to be stable against overturning, if exposed to the pressure of water standing level with its top on one side only?

6. Compute the tension in pounds per square inch in the metal of a water pipe, if the metal be $\frac{1}{2}$ inch thick, the inside diameter of pipe 2 feet, and the water pressure that due to a static head of 207 feet.

7. The diameter of a steam engine cylinder is 9 inches, the length of crank 10 inches, the number of revolutions per minute 110, and the mean effective pressure of the steam 35 pounds per square inch. Find the indicated horsepower.

Materials and methods of construction. Properties and characteristics of the various materials used in engineering construction; proper tests to be applied to ascertain their strength and other qualities; methods employed in preparing and placing the materials in the work; definition of technical terms.

The questions which have been given have related to stone and brick masonry, methods of laying and bonding various classes of masonry, and the qualities of the several materials entering into their construction; to the different kinds of hydraulic cements, their strengths and methods of testing; to concrete, the proper proportions of the several ingredients and methods of mixing and depositing under different conditions; to the different kinds of roads and pavements, the materials used and methods of building; to the properties and characteristics of cast iron, wrought iron and steel, to the uses for which each is best adapted, and to their strengths and methods of testing the same. Definition of technical terms in common use in engineering specifications.

SCHEDULE B, CLASS 13, DIVISION D (ASSISTANT ENGINEER, SENIOR GRADE).

Education and experience. Same as Division A.

Trigonometry. Plane trigonometry, — trigonometrical functions, properties of logarithms and use of logarithmic table, solution of triangles, either right or oblique, by either natural functions or logarithms.

Sample Questions.

1. The value of the tangent of a certain angle is $\frac{5}{12}$. Without using tables, find the value of sine, cosine, cotangent, secant and cosecant, and show clearly your method.
2. Water runs 42 inches deep in a 48-inch circular conduit. What is the area of the water section?
3. By logarithms obtain the value of the following expression: —

$$\frac{(0.68291)^{\frac{3}{2}} \times \sqrt{5.9548} \times \sqrt[3]{61.2}}{\sqrt[5]{298.543}}$$

4. Two tangents to a circular curve of 2,900 feet radius intersect so as to include an interior angle of 157° 8′. Find the length of either tangent from point of contact with curve to point of intersection, using natural functions.
5. A distance *A B* across a stream is to be determined. A base line *A C*, 220 feet long, is measured off on one bank, sights are taken from each end of it to *B*, and the angles which the lines of sight make with the base are measured, *A* being 104° 53′ and *C* 58° 11′. Compute the distance, *A B*, using logarithms.

Engineering theory. Same as Division C.

Materials and methods of construction. Same as Division C (*except for surveyors* *).

Designing. This subject requires the applicant to make a complete design of an engineering structure in the particular line of work in which he is engaged, or in which he seeks employment, and to answer pertinent questions as to the actual work of construction. Data to the extent usually available in actual practice will be given, and from these the applicant must make the necessary computations, prepare plans and sketches, showing clearly his design, and write a brief specification of the work to be done, the whole to be in sufficient detail to enable a definite proposal to be made for building the proposed structure.

In the examinations which have been given under this subject, a whole day has been allowed for the work, and the applicant has been permitted to use, subject to the approval of the examiners, any tables, diagrams or other labor-saving devices with which he is familiar.

The designs which have been called for in examinations already held are: a steel highway bridge of 120 feet span; a main trunk sewer to meet given conditions; a city street with irregular grades and car tracks.

SCHEDULE B, CLASS 13, DIVISION E (DRAUGHTSMAN).

Handwriting.
Spelling.
Education and experience.
} Same as Division A.

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* For surveyors (instead of materials and methods of construction): Advanced surveying. Questions in geodetic, topographic and hydrographic surveying; methods of accurate land surveying and levelling in cities; details of the work of laying out and grading new streets and relocating old streets; evidence of ownership in disputed boundary lines. Surveying problems.

Arithmetic. Including common and decimal fractions, percentage, square root, mensuration of rectangular surfaces and solids.

Sample Questions.

1. Change the following lengths to feet and inches, giving the answers to the nearest eighth of an inch: 12.56 feet; 6.82 feet; 4.20 feet.
2. Divide one and six-hundred-sixteen thousandths by eight ten-thousandths.
3. Add $\frac{11}{14}$, $\frac{3}{10}$ and $\frac{18}{21}$, and from the sum subtract nine thousand one hundred forty-seven hundred-thousandths. *Carry the work to five places of decimals.*
4. Twenty-five thousand feet, board measure, of 2-inch plank were sent from the lumber yard to cover the roadway of a bridge 260 feet long and 42 feet wide. What per cent. of the planking was wasted?

Algebra. To and including the solution of simultaneous equations of the second degree.

Sample Questions.

1. Multiply $\frac{10\,a^3\,y}{9\,bx^2}$ by $\frac{3\,b^4\,x^3}{4\,a^3\,y^2}$.
2. Divide $x^6 - 6\,x^4 + 5\,x^2 - 1$ by $x^3 + 2\,x^2 - x - 1$.
3. There are three numbers. If we add $\frac{1}{2}$ the first to $\frac{1}{3}$ the second plus $\frac{1}{4}$ the third, the sum will be 62. Or $\frac{1}{3}$ the first plus $\frac{1}{4}$ the second plus $\frac{1}{5}$ the third equals 47. Or $\frac{1}{4}$ the first plus $\frac{1}{5}$ the second plus $\frac{1}{6}$ the third equals 38. Find the numbers.
4. Solve the equation $4\,x - \frac{14 - x}{x + 1} = 14$.
5. A rectangular plot of ground is surrounded by a walk 7 feet wide. The area of the plot and walk is 15,000 square feet, and of the walk 3,696 square feet. Find the length and breadth of the plot.

Geometry. The applicant will be expected to have such familiarity with the principal theorems of plane and solid geometry as will enable him to solve simple problems dealing with lines, angles, areas and volumes. *Demonstrations of theorems will not be required.*

Sample Questions.

1. Through the vertex of a right angle a straight line of indefinite length is drawn, lying outside the angle. What is the sum of the two acute angles thereby formed? *Give your reasoning.*

2. If the angle at the vertex of an isosceles triangle is a right angle, what ratio exists between the base and the altitude? *Give your reasoning.*
3. Supposing a tangent drawn to a circle from a given point without; show by a sketch how you would determine the precise point of tangency. *Give the reasons for your method.*
4. The bases of a trapezoid are 32 feet and 20 feet respectively. Each of the other sides is 10 feet. Find the area of the trapezoid.
5. A cubic foot of brass is drawn into a wire $\frac{1}{8}$ of an inch in diameter. Find the length of the wire to the nearest foot. $\pi = 3.1416$.

Trigonometry. Plane trigonometry, — trigonometrical functions, properties of logarithms and use of logarithmic table, solution of triangles, either right or oblique, by either natural functions or logarithms.

Sample Questions.

1. In a triangle $A\ B\ C$ the angle A is 90°; the side $A\ B$ is 4 units long, $A\ C$ 3 units, and $B\ C$ 5 units. State, from inspection of the figure, the value of the cosine of the angle C; the sine of B; the tangent of C; the secant of B.
2. Construct on paper an angle of 53° 14′ by means of its tangent (to be obtained from the tables), and explain your method.
3. Multiply 4978.3 by $(0.2916)^3$ and divide the result by $\sqrt[5]{1.985}$, using logarithms for all the computations.
4. A regular octagon is inscribed in a circle of 8 feet diameter. Compute the length of a side, using only natural functions for the angles.
5. From a point in the same horizontal plane with the base of a tower, the angle of elevation of its top is 50° 39′; and from a point 100 feet further away it is 35° 16′. Required, the height of the tower.

Duties. Questions relating to the implements, materials and methods used in making maps and plans. Details of plans, such as lettering titles, coloring and ornamenting; scales, north points, etc.

Methods of duplicating, preserving and cleaning plans, etc.

Tracing. Same as Division A.

Plotting. Plotting a survey by co-ordinates from field notes, inking-in plot and lettering a title.

Sample Question.

Plot accurately, on a scale of 30 feet to an inch, the survey of a parcel of land given in the following notes: —

Station.	Bearing.	Distance.
1.	N. 48° 30′ E.	213.00 feet.
2.	S. 42° 15′ E.	193.80 "
3.	S. 49° 15′ W.	162.00 "
4.	N. 82° 15′ W.	77.40 "
5.	N. 42° 45′ W.	133.20 "

Locate station one 5½ inches from the bottom of the drawing paper and 2 inches from the left margin.

Ink-in the plot, mark the bearing and length of each side, draw a north point and letter the following title, making your own arrangement: "Plan of land in Boston belonging to John Smith, March, 1898. Scale, 30 feet to an inch."

Drawing. This subject calls for the making of a detailed drawing of an engineering structure, the whole to be finished in india ink and neatly lettered. A rough sketch will be furnished, giving the general dimensions of the structure, and such other data will be supplied as a chief draughtsman or designer in actual practice would give to his assistant to enable him to prepare a set of working drawings.

In examinations already held, the applicants have been required to make the drawings of a masonry abutment for a highway bridge.

SPECIAL INSTRUCTIONS TO EXAMINERS.

The members of a Board of Civil Service Examiners will meet as soon as practicable, and organize the Board, choosing a chairman and secretary.

On receiving notice of such organization, the commissioners will forward to the secretary of the Board the application blanks, copies of the rules and regulations, and such other books, documents and papers as may be needful.

Each person filing an application blank should be furnished also with a copy of the rules and regulations.

When an application paper is presented by an applicant in person, the secretary should examine it at the time, if he can do so conveniently, and, if it is properly filled out, he should note upon the back, in ink, the date and hour when received. If it is not properly filled out, the attention of the applicant should be called to the fact, and he should be directed to have the application paper corrected.

If an incomplete application paper is received by mail, it should be returned to the applicant, accompanied by a notice to correct the same.

The applications, if found satisfactory, should be numbered serially in the order in which they are received. They should be entered in the record of applications, in the order of their numbers.

Any application which shows that the applicant is not, by reason of age, lack of citizenship, proper period of residence, etc., entitled by the law, rules and regulations to an examination must be returned to him with a brief statement of the reasons for such action. A blank form will be furnished for this purpose.

All application papers will be received, if in proper form. Should any be received for positions in the service of the Commonwealth, or another city, they must be forwarded to the commissioners.

When the application is for examination for the police service, the secretary of the Board will furnish the applicant with a copy of the book of instructions for police applicants, *and make note of having done so on the application paper.*

Attention is called to Rule XIX., which gives precedence in notification to veterans.

Examination blanks will be sent or brought to the Board before an examination is to take place; but they are not to be opened until the Board meets in the examination room on the morning of the examination day, and great care must be taken that they be kept in a secure place until that time.

When all are seated, one of the Board will take from each applicant the notice he has received to attend the examination.

The package of examination papers will then be opened, and each applicant will be given a numbered envelope and a declaration paper; upon the latter are printed questions concerning his name, age, former occupation, service as a veteran, etc. These are to be answered in writing, and the writer will sign his name at the bottom of the sheet. This is the only time during the examination when the applicant will be allowed to affix his signature to a paper. After completing the declaration paper, he will fold and enclose it in the numbered envelope which has been given him, and then seal the envelope.

The number on the envelope will be his examination number, and he must write it upon each succeeding paper in the blank space left for that purpose.

It will be well to inform the applicants that they are to be examined in certain subjects, and state the order in which the subjects will be given out.

The envelopes are not to be opened until after all the examination papers have been marked and graded.

In examinations where one of the exercises consists of writing from dictation and spelling, all the applicants will work at the same time. In the other exercises they may consult their own convenience as to rapidity.

As a rule there will be no general recess during the examination hours; but any applicant may be allowed, for sufficient reason, to leave the room at any time when he has finished one set of questions and delivered the paper to one of the Board. No succeeding questions shall be given him, however, until his return.

It is advisable that the full Board of Civil Service Examiners be present at each examination; but a majority of the Board may conduct an examination in case of the disability or necessary absence of the other members.

Applicants should be cautioned not to use any books of reference or memoranda for the purpose of assisting their memories. Any one detected in doing so may be dismissed from the examination room. The same penalty may be enforced if one applicant attempts to assist another, by conversation or otherwise, in answering the questions given him.

Members of the Board should give the applicants general explanations only, and these should be limited to methods of procedure.

After an examination, all the papers should be taken charge of by the secretary of the Board.

Members of local boards are cautioned against furnishing information to any person in relation to the examinations, except in the general way prescribed in the rules.

All unused examination papers are to be returned to the commissioners the day after the examination.

As soon as practicable after completing the marking and grading of the papers, the secretary of the Board will send a certificate to each person who was examined, if he passed the examination, stating the standing which he obtained, as shown by the marking. He will also send notice to each applicant who failed to pass the examination, informing him of the fact.

In the general regulations adopted by the commissioners will be found information as to marking and grading, and the enrolment in the proper register of the names of those found eligible for appointment.

The chief examiner will be present at the examination whenever it is practicable to do so.

More specific rules for marking the examination papers will be issued hereafter.

Necessary expenses incurred by members of the Board for stationery, postage and actual travel, will be allowed by the commissioners.

HENRY SHERWIN,
Chief Examiner.

FORMS FOR APPOINTING OFFICERS.

[The following forms are furnished for the information and convenience of officers making appointments to positions in the classified service of the Commonwealth and the cities thereof. They are furnished merely by way of suggestion, and not as forms prescribed by law to be strictly followed.]

Form for Nomination, by a Mayor, of Police Officers—Probationary Term.

I hereby nominate, subject to the approval and confirmation of the Board of Aldermen,   , to be a police officer of the city of   , with all the powers of a constable except the power of serving and executing civil process, to hold said office for a probationary period of six months, as provided in the civil service rules of the Commonwealth, unless sooner discharged.

Form for Nomination, by a Mayor, of Police Officers—After Probationary Term.

                , having served as a police officer for a probationary period of six months, and his conduct and capacity having been found satisfactory, I hereby nominate, subject to the approval of the Board of Aldermen, said   , to be a police officer of the city of   , with all the powers of a constable except the power of serving and executing civil process.*

Form of Warrant for Police Officer appointed for Probationary Term.

This is to certify that   has been appointed a police officer of the city of   , with all the powers of a constable except the power of serving and executing civil process, said appointment being made under the civil service rules of the Commonwealth for a probationary term of six months, beginning on the   day of
A.D. 19 .

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* In cities where the ordinances provide that appointment shall be made for a limited time, it would be well to add, "to hold office for the term and according to the tenure prescribed by the laws and ordinances."

Form of Warrant for Police Officers appointed after Probationary Term.

This is to certify that , having served a probationary period of six months, as required by the civil service rules of the Commonwealth, has been appointed a police officer of the city of , with all the powers of a constable except the power of serving and executing civil process.*

Form of Notice to Persons, other than Police Officers, appointed for a Probationary Term.

This is to inform you that, under the provisions of the civil service rules, ha selected you for appointment to the position of in the for a probationary term of six months from the date when you begin service. Should your conduct and efficiency during such probationary term prove satisfactory, you will, at its close, receive a regular appointment; otherwise your appointment will cease. The salary attached to such position is at the rate of $.

This conditional appointment does not preclude prompt discharge from service at any time during such probationary term, in case of misconduct or inefficiency.

A prompt reply is requested, stating whether this appointment is accepted, and giving the earliest date when you can present yourself for service.

Notice to Persons, other than Police Officers, appointed after Probationary Term.

Your conduct and capacity, during the probationary term of six months, having been found satisfactory, you are hereby appointed a in the department [or office] at a salary of $, beginning on the day of , A.D. 19 .

Notice to Persons whose Conduct or Capacity has not proved Satisfactory during the Probationary Term.

I have to inform you that your conduct [or capacity] during your employment in department as , for a probationary term of six months, has not been found satisfactory, and that, in accordance with the terms of your original appointment, as prescribed in the civil service rules of the Commonwealth, your employment in said department will cease on the day of , A.D. 19 .

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* See note to second form.

INSTRUCTIONS TO APPLICANTS AND ELIGIBLES.

A person desiring to be examined for a position in the classified service should file an application on the prescribed blank, and a form for that purpose can be obtained at the office of the commissioners, room 152, State House, Boston, or of the secretary of the local board of examiners in the city where he lives.

Applications for the service of the Commonwealth and of the city of Boston should be filed in the commissioners' office, Boston; if for service in any city other than Boston they should be filed with the secretary of the board of civil service examiners in such city.

Applications will be received at any time, and notice of the time and place of examination will be seasonably sent to each applicant. If unable to attend the first examination after applying, the applicant will, upon satisfactory explanation, be notified to attend the next examination.

Non-competitive examinations are not given when it is practicable to establish an eligible list by competition, and they are never held at the request of an applicant.

The commissioners cannot furnish information as to the course of preparation which applicants should follow (except as shown by the specimen examination papers printed in their report), nor can they answer inquiries in relation to cases which are not before them for decision, or decide, except in the cases of actual applicants, questions respecting the application of the rules. Particular answers cannot be given to inquiries which are answered herein, directly or by implication.

Notice will be sent by mail to each examined applicant of the result of his examination as soon after the examination as it is practicable to do so.

The names of persons who have passed the required examination will remain on the eligible list two years from the date of their certificate, unless dropped therefrom after certification three times, or removed from said list for cause.

Applicants for clerical service whose names have been placed on the eligible list in Class 2 of Schedule A may also, *upon request in* *writing*, have their names placed on the eligible list for positions in Class 1 of Schedule A, with the same standing.

Applicants for clerical service in the departments of the Commonwealth whose names have been placed on the eligible list may, *upon request in writing*, have their papers marked by the local board of examiners of the city in which they reside, and their names placed on the eligible list for service in the departments of such city, and *vice versa*.

Persons whose names have been placed on the eligible list in Class 1 of Schedule B (prison service), and who have been certified for appointment, will be subjected to a physical examination if the appointing officer so requests.

The relative standing of any applicant as compared with that of others on the same eligible list may be changed by the addition of names of persons who have obtained higher standing at some more recent examination, and the time of the examination is not considered in making certifications.

Eligibles are certified in the order of their grade, and nothing can help and nothing can hinder their certification for appointment in the order of eligibility as prescribed by the civil service rules.

The commissioners are unable to answer inquiries as to vacancies in the service, salaries, prospects of certification, appointment or promotion. They know nothing of vacancies until requested to certify names for filling them, and it can only be generally said that the highest mark possible is 100, the lowest which gives eligibility is 65, and that the nearer the applicant's mark is to 100 the more likely it is that his name will be reached for certification. It is wholly uncertain, therefore, when an applicant's name may be reached for certification, and it is useless to speculate on what his chances may be.

Applicants will save the commissioners and themselves time and trouble by carefully reading the foregoing and preserving it for reference.

WARREN P. DUDLEY,
Secretary.

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NINTH ANNUAL REPORT

OF THE

MASSACHUSETTS HIGHWAY COMMISSION.

JANUARY, 1902.

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1902.

Commonwealth of Massachusetts.

To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts in General Court assembled.

The undersigned commissioners, appointed under the provisions of chapter 476 of the Acts of 1893, entitled "An Act to provide for the appointment of a Highway Commission to improve the public roads, and to define its powers and duties," and under the provisions of chapter 474 of the Acts of 1900, entitled "An Act relative to the Massachusetts Highway Commission," herewith submit their ninth annual report.

W. E. McCLINTOCK.
HAROLD PARKER.
JOHN H. MANNING.

BOSTON, MASS., Dec. 26, 1901.

LIST OF OFFICERS OF THE MASSACHUSETTS HIGHWAY COMMISSION.

William E. McClintock, **Harold Parker,** **John H. Manning,**	*Commissioners.*

Austin B. Fletcher,	*Secretary.*

John M. McCarthy,	*Clerk.*
Edward A. Austin,	*Clerk.*
Mary A. Riley,	*Stenographer.*
Elting J. O'Hara,	*Stenographer.*
Alice M. Worthen,	*Copyist.*
Fred Fair,	*Office Boy.*

ANNUAL REPORT

OF THE

MASSACHUSETTS HIGHWAY COMMISSION.

In accordance with the provisions of the act of July 10, 1900, appropriating for the construction and maintenance of State highways, $100,000 became available for the use of the commission on Jan. 1, 1901. On April 10, 1901, the sum of $500,000 was appropriated by the Legislature for the same purpose, and with the condition that $100,000 should not be available until Jan. 1, 1902. The commission, therefore, has had the sum of $500,000 which could be used for work during the year. In addition to the $100,000 held over from the appropriation of 1900, considerable sums allotted for expenditure during that year were actually disbursed during the year 1901, unavoidable delays having prevented the completion of several contracts.

Additional lay-outs were made during 1901, amounting to 325,705 feet (61.68 miles), bringing the grand total up to 1,993,643 feet (377.58 miles). The number of miles of road finished during the year was approximately 62, making a total of about 358 miles of completed State highway at the end of the year 1901. On most of the remaining 20 miles laid out but not completed the work is in various stages of progress, although in a few instances no work will be done under the contracts before the coming spring.

MEETINGS OF THE COMMISSION.

The commission has held 81 meetings at its office in Boston during the past year, besides many others at different points in the State. The regular hearings provided for in the statutes were held, at least one in every county in the State. These hearings have generally been well attended.

Important discussions have occurred at these meetings, touching upon methods of construction, materials and road machinery, and the commission has thereby been enabled to give and to obtain much valuable information. From the testimony of the selectmen the commission is much pleased to report that fully fifty towns in different parts of the Commonwealth have made appropriations and built macadam roads.

The macadam roads thus built by the towns since 1894, and independent of the State roads, measure in the aggregate about 500 miles. The object lesson furnished by the State has had its effect on the towns, and they are in most instances carefully considering drainage, foundation and other details of construction.

In addition to the county hearings, over 175 special hearings, relating to particular petitions, have been held, mostly in the office in Boston. During the winter months these hearings consume a large share of the time of the commission, but information is thus obtained as to local conditions that is of great value to the commission when the allotments are made.

The method adopted last year, of dividing the State into three divisions, with each member of the commission to investigate the needs of his division, has worked very satisfactorily during the present year. Under this system there have been few delays, and in the "small town" work particularly it has been possible to determine the local conditions and make recommendations as to what should be done and the best manner of doing it. The whole Board has, in addition to the division work, made various trips to different parts of the State, in order to acquaint itself with the general manner of constructing and maintaining the State roads, and also to examine roads which the municipal authorities have petitioned to be taken as State roads. The commissioners find such trips to be absolutely necessary to keep them in touch with the work.

CONTRACTS.

All work done by the commission must be done by contract, either with the town or city authorities, or, after due advertisement, with private contractors.

The main difficulty in carrying on road work by contract is the delay which occurs from the breaking of machinery and from the lack of labor. In the agricultural districts it is often impossible to hire men during the season of harvesting the crops, and consequently all work ceases for a time. So far as possible, contracts are let so that the work can be prosecuted at such times as not to interfere with the farm work, but such action is not at all times possible.

Many of the men employed by the commission to look after the State's interests have been at the work several years, and are thoroughly competent. Other men lack judgment at critical points, and cause more or less trouble to both the commission and the contractor; but the number of experienced men is increasing each year, and as a result the work proceeds more evenly, while the cost is being reduced.

Surveys of contemplated roads are made so as to give ample time for the studying of the grades and drainage; and in the main the work is being carried on in a very satisfactory manner. Many of the surveys are made in the winter by the resident engineers, thus keeping them at work, and making it possible to give them permanent employment and prevent their seeking employment elsewhere, which would be likely to occur if they were dropped even for a short time.

During the year 87 contracts were entered into, of which 27 were with town or city authorities and 60 with private individuals or corporations.

PETITIONS.

The total number of petitions for the location and construction of State highways up to the issue of this report is 561. Fifty-three new petitions were received during the year 1901. These petitions cover 1,469 miles of road, and they are from 277 towns and 25 cities. All of the petitions received during the past year were from towns, and they cover 135 miles of road not previously petitioned for.

STREET RAILWAYS.

The difficulties resulting from street railway tracks upon State highways, referred to in the last report of the commission, have materially increased during the year. There are at the present time street railways operating on State roads in 99 different cities and towns. In 4 of these municipalities there are 2 different companies. The length of street railway tracks has been increased by 251 miles during the year, while 32,200,000 more passengers were carried than during the previous year.

There is a gradually growing tendency on the part of the town authorities to have the street railway tracks placed well out toward the sides of the roads and clear of the travelled way. In many instances the street railway companies have placed their tracks at a permanent grade and graded the entire width of the travelled way, thus obviating the necessity of any further movement of the tracks.

Two petitions have been received by the commission, jointly signed by the selectmen of the towns and the presidents of the street railway companies, for the establishment of lines and grades of the tracks of the street railway companies, the grading of the highways and partial payments of the cost of grading by the Commonwealth, in accordance with the provisions of section 38, chapter 112 of the Revised Laws. In both instances the benefit to the traveller by either the street railway or the highway would be great. No official action has yet been taken on these petitions, as they were presented after the allotments for the year had been made by the commission, and consequently there were no available funds.

Chapter 112 of the Revised Laws requires all street railway companies to pay an excise tax to the different cities and towns, based upon the ratio of the miles of track in the city or town to the total miles operated by the railway company. Section 11 specifies that street railway companies shall not be required to keep any portion of the surface material of streets, roads and bridges in repair. It is unquestionably a fact that on State roads the Commonwealth is required to perform the same duties as are performed by municipalities on their roads, and maintain the surface of that part of the highway location occupied by the street railway tracks. The additional cost resulting from this class of work apparently increases the annual cost per mile of maintenance of State highways; but it works no hardship on the Commonwealth, as in no case will the amount thus expended be equal to the $50 per mile which may be charged to the town as its share of the annual cost of maintenance.

Section 45, chapter 112 of the Revised Laws, reads as follows: "If, upon the trial of an action against a city, town, railroad corporation or bridge corporation, the plaintiff recovers damages for an injury to his person or property which was caused by reason of a defect in a street, highway or bridge which is occupied by the tracks of a street railway company, and the street railway company is liable for such damages and has had reasonable notice to defend the action, the city, town, railroad corporation or bridge corporation may recover the damages, and all the costs of both plaintiff and defendant in the action from the street railway company."

In an opinion of the Attorney-General, given to the commission during the past year, it would appear that the Commonwealth may be required to defend a suit for damages for injuries to a person travelling in a street railway car. The opinion further says: "If in such a case the Commonwealth were obliged to pay damages, there is no statutory provision giving a remedy over against the street railway company to the Commonwealth, as is provided in the case of cities, towns, steam railroads or bridge corporations." This is such an obvious oversight that the commission feels that it has but to call attention to it to have a correction made.

In the last report of the commission attention was called to the defective system of granting locations to street railway companies by boards of selectmen. The commission wishes to emphasize what it said a year or more ago, and urges the necessity of placing the approval of such locations in the hands of one central authority. With the law as it now stands, two or more rival street railway companies may obtain locations from the same local board over the same road, or one company may obtain a location in one town and another company may secure the right of way in the adjacent town, the result being that the building of a through street railway becomes an impossibility. A carefully worded opinion of the Attorney-General satisfies the Board that it has no power to adjudicate on petitions of different street railway companies, but must approve or disapprove locations granted by local authorities, and in the order in which they reach the commission. While the present law might have been thoroughly satisfactory up to a comparatively recent date, there can be no question that, with the present enormous growth of the street railway system, it is obsolete, and should be made to conform to the changed conditions.

In the main, the relations of the Highway Commission and street railway companies are satisfactory. There are many questions of law not as yet well understood, but, as the street railway companies are willing to meet the commission on fairly liberal terms, no special reference will be made to them at the present time.

COUNTY ASSESSMENTS.

In accordance with the provisions of the statutes, the several counties in which State roads are built are required to repay to the State one-quarter of the amount expended during the year. The time of this repayment may, if desired, extend over six years from the date of the assessment; but in several instances, including some of those in which the amount of the assessment is greatest, the counties have preferred to pay the entire sum due at the end of each year. The amount assessed upon the counties during the year 1901 was $107,505.30.

ESTIMATES FOR 1902.

For the year 1902 the commission has recommended an appropriation of $500,000, with the condition, as heretofore, that $100,000 should be available only after Jan. 1, 1903. This sum is believed to be necessary and sufficient for the proper extension of the great system of State highways, of which already more than 350 miles have been constructed. The commission is of the opinion that the sum recommended can be expended with greater efficiency and economy than either a larger or a smaller amount; and it also believes that an appropriation of this sum for each year, for at least two years in advance, would greatly facilitate all engineering and construction work, and materially reduce the cost of the same.

LAND AND GRADE DAMAGES.

The laying out of State highways has been much expedited and many costly delays prevented by the act of last year, which enables local boards to save the Commonwealth harmless against all claims and demands for damages which may be sustained by any person whose property has been taken for or injured by the construction of any highway which the Highway Commission proposes to lay out and construct as a State highway. It is now and always has been the policy of the Highway Commission to cause as little damage to abutting land owners as is consistent with good grades and complete drainage, and to perform such work as may seem necessary to do away with unsightly features and to allow of a reasonably safe use of driveways. The releases of either the abutters or local boards are intended to protect the Commonwealth against unjust claims.

It often happens that after a careful study of a lay-out and grade there are individual cases where injury is preventable by a slight and comparatively unimportant change of either line or grade. The Board is always ready to consider such changes, even although a release has been signed.

For outstanding claims against the Commonwealth, see Appendix C.

CONSTRUCTION.

The methods employed by the commission in building State roads have been thoroughly described in previous reports, and will not be repeated at this time.

The main difficulty the commission has to contend with is to apply the method which will give perfectly safe and at the same time economical results when the road to be built passes over a sub-grade of doubtful soil. Such roads can be built to bear up the heaviest load that may be expected to pass over them during all conditions of weather; but when the drainage and foundation which may seem to be necessary to produce good results are effected, the cost is great, and unless these precautions are required, the heavy cost is unnecessary.

It is a well-known fact to road builders that, with reasonably good grades, the surface of the road is much easier to maintain on grades than on the low ground between two hills or on any flat grade. This is particularly true of gravel roads.

The soils found in the sub-grades may be divided into three general classes; first, sand or gravel; second, clay; and third, sandy loam.

1. *Sand or Gravel.* — The thickness of the roadway surfacing over sand and gravel is determined by the weight and volume of traffic alone. On roads of light traffic this thickness is four inches, which is increased to six inches on heavy-traffic roads.

The increased thickness is used more particularly to reduce the cost of maintenance, as by its use the road will wear a much longer period of time before it will require picking up and resurfacing.

The main feature of building thin macadam roads over sand is to thoroughly compact the stone by rolling before opening them to traffic, as by so doing subsequent movement of the fragments of broken stone is prevented, and ruts will not develop.

2. *Clay.* — Clay as found in sub-grades is a variable substance. It may be a pure blue clay, or it may be mixed with sand in different proportions. The pure blue clay sub-grade requires heroic treatment, if positive stable results are expected. The ground water must be removed as far as possible, to insure a reasonably dry foundation. This may be done by one or two side drains, the number depending upon the general slope of the adjacent ground, or by a centre drain.

It is customary to place one drain on the up-hill side, and one on each side in a cut or on a level grade. It is not at all times an easy problem to determine whether side or centre drains should be put in, and no general rule can be laid down that will cover this part of the work. A special study must be made of the sub-grade and of the stone or gravel supply, and comparative estimates based upon these studies will make an intelligent conclusion possible. If a good quality of gravel can be found within a reasonable distance from the road which is being built, it is economical to spread it on the roadway to a depth of from two to six inches over the clay sub-grade, and on this gravel to spread the broken stone. The gravel thus placed serves a double purpose, — it improves the drainage and reduces the depth of the broken stone surfacing. Gravel placed in this manner should be used only when it can be placed on the road for a price that is less than would be paid for broken stone; at the same cost per cubic yard, broken stone is preferable.

Clay that is mixed with more or less sand has to be studied very carefully. If the percentage of sand is large and the grains of sand coarse, the drains on grades may possibly be omitted and probably need be put over only fairly level places, and the thickness of the broken stone and of the gravel may be lessened. If, on the other hand, the sand be fine-grained and in smaller proportion, a great deal of judgment is needed to know just how it should be treated.

The standard thickness of covering should be used on level stretches, with a possible reduction in depth on grades. If any weakness develops later on, the thickness of covering may be obtained by spreading on more stone and rolling it.

On the same principle, the drains may be omitted at the time of building, putting them where needed only at any subsequent time, if the roadway shows indications of rutting.

3. *Sandy Loam.* — A sub-grade of sandy loam is the most difficult to know how to treat. Generally speaking, if thirty per cent. or more of the material will pass through a No. 100 screen, the introduction of a drain does no particular good, the capillarity of the soil being so great that it will not give out the ground water. Under frost action the bearing-up properties are very poor, and the thickness of the covering will have to be increased until the weight is distributed over an area large enough to reduce the pressure to a safe limit.

When this kind of soil is met with, it is exceedingly variable in quality, and unless tests are made at very short intervals, its character cannot be determined. It is therefore well to place the broken stone, or stone and good gravel, on the road to a depth of twelve or fourteen inches when the sandy loam is known to be poor, and to reduce this thickness to six inches when it is of doubtful quality. If in the use of the road weak spots develop, these spots can be strengthened by placing more stone over that already there, and thus increase the thickness. By this method no greater outlay is incurred than is actually necessary, as determined by experience.

The commission finds that each year the number of good road builders is increasing. In its early work few of the engineers employed by the commission, or of the superintendents or road commissioners engaged on town work, had had experience in modern road building. A marked improvement is shown in the engineers, while many of the towns' road officers are capable of building as good a road as is built by the commission. In many cases where a town has taken the contract to build a State road, and their superintendent is fitted to do so, he is allowed to proceed without a resident engineer. It is the intention of the commission to conduct the work in this manner wherever possible, as by so doing a large saving can be made in the engineering expenses, while the town officers will be benefited by the experience. An occasional visit of the division engineers to the different roads under construction will enable the commission to see that the contracts are being properly carried out. Another change in the same direction is to build without any preliminary survey, whenever the road to be built presents no unusual features.

GRADES.

The importance of reducing hills to a reasonably low grade has been referred to so many times in the reports of the commission that there seems no necessity for repeating the arguments at the present time. The commission, so far as possible, is grading long stretches of road and covering them with the best available material, leaving the more permanent surfacing to be done in the future and at those parts only that require it. There can be no question but that such treatment will be thoroughly satisfactory. It will materially increase the efficiency of the entire length of the road, and will do it at a cost much below what would be entailed by completing short sections at different times.

COST.

The commission has constantly in mind the cost of the roads built under its direction, and by a careful study of each road to be built strives to eliminate every item which appears to be unnecessary to give good and lasting results. The conditions met with in some parts of the State are so complex that the average cost per mile for the entire Commonwealth will continue to be fairly high, notwithstanding the simple requirements of other sections.

No class of public work offers greater opportunity for watchfulness than does road building. This watchfulness must begin with the preliminary survey and continue throughout the planning and building, and end only when the last stroke of work is performed. Imperfect planning and incompetent supervision are the two principal causes of unnecessarily high-cost work. When the survey of a road is now ordered, ample time is allowed to carefully study the quality and location of materials, the nature of the sub-soil which is to constitute the foundation, the different parts of the drainage problem, and the grades.

Particular attention is paid to the old surfacing material, with reference to utilizing it as far as possible; and it frequently happens that this last item determines the thickness of broken stone or gravel to be placed on the improved roadway. While there still remain many opportunities, the commission feels confident that great improvement is shown in planning the work. With the increased experience, which can only come from long-continued practice, the engineers charged with looking after the interests of the Commonwealth, and the contractors, whether municipal or private, who are building the roads, are performing their duties more intelligently and consequently more economically. During no year since the commission began its work have better roads been built, and at no time has the average cost per mile been so low as during the present year. The fact must not be lost sight of that many of the cities and towns have by vote accepted the eight-hour day permitted by legislative enactment. Some of these same municipalities have fixed the rate of labor at two dollars per day. Under such conditions it is hardly reasonable to suppose that the low cost of road building in some of the neighboring States can be reached in Massachusetts.

In Appendix G will be found a table showing the cost per mile of roads built during the year 1901.

MAINTENANCE.

The cost of maintaining State roads, being, as it must be, a constantly increasing item, has caused the commission many hours of thought and investigation. In making the annual report of this expenditure it is but fair to say that all the money received from the various towns for State road maintenance, within their respective boundaries, is received by the State Treasurer, and is not credited to the Highway Commission; so that, as the length of the State highway system increases, the repair account also grows, and, notwithstanding the payments made by the towns, less is each year available for construction out of the annual appropriation.

Under the street railway law of 1898 the excise tax paid by street railways to towns for the maintenance of roads over which they are built must still be paid to such towns, although it may well be that all the street railways within the limits of such towns are located on State highways. As the purpose of this law was to pay back to towns the extra cost of maintaining roads caused by the presence of street railways upon them, it does not seem just that this amount should be so paid where the cost of such maintenance is borne by the State.

In constructing a system of State roads, the object has been and is to secure for the State a net-work of thoroughly built highways, connecting the towns together and ultimately reaching every part of the Commonwealth. These highways are devised and built upon the most approved methods, with grades, drainage and foundations designed to last forever, with proper care, the only perishable portion being the surface. It is necessary, then, to keep a constant watch on this portion of the roads, to see that no defect remains uncorrected; that any depression that will hold moisture is immediately filled; that all accumulations of sand or mud are removed; that all outlets for the immediate escape of water are kept free; that grass in grass gutters is mowed; and that innumerable other items of care are attended to. In addition to all this, the original stone or gravel surface in time wears out and must be removed. This is what the care of State roads means, and it has been the aim of the commission to find out the most economical way to do it. Where continuous sections of State road exist, as is now the case in many parts of the State, it has been found well to make contracts with reliable persons or with towns to care for specified lengths of road for an agreed-upon price, under the direction of the engineers of the commission. Where the sections are small, this method cannot so well be employed, and in such cases the engineer makes the required repairs, as occasion demands.

Some criticisms have been received of roads that have worn out sooner than they apparently should. That this is a just criticism the commission fully believes. The commission, however, points with some degree of satisfaction to the State highways of Massachusetts as a whole. Many different kinds of stone have been used, for the purpose of discovering the most economical, and some have proved inadequate, but in no instance has more than the surface given away.

The commission has used gravel for building and repairing

State roads wherever such use has been warranted. It is plain that in many parts of the State no gravel can be found, and in these parts either gravel or broken stone must be imported; and, where the cost is approximately the same, broken stone has usually been employed, being more enduring. In other parts good gravel prevails. In these locations it is the opinion of the commission that the State roads should be made and repaired with gravel, except in places where the travel is heavy and constant. Whether a State road is of stone or gravel, the same method of preparing the sub-grade for the surface is employed, so that, if a gravel road proves insufficient, its surface can easily and at a small cost be covered with stone.

"Small Town" Work.

Under the provisions of chapter 432 of the Acts of 1900 there have been filed with the commission 131 petitions, from 86 towns; and 74 allotments have been made, in 63 towns.

As a result of the studies of the highways and town ways in the various towns, it is found that there has been a constant deterioration of the road surfaces for many years. This is due to several causes. The first, and the principal one, comes from a general disregard of necessary drainage. In nearly all of the towns the gutters are filled with vegetation, or have been neglected for so long a time that the roadway becomes its own drainage bed. The next cause, and one perhaps equally as injurious in its effect, is the wrong use of the road machine. The road machine, when used for shaping new construction and for cleaning the gutters of worn-out material which has been washed from the road, is very useful; but when it is used for scraping upon the surface the worn-out material washed to the sides, the result is a most serious injury, making a road dusty in dry weather and muddy in wet weather, and possessing not a single good quality. Not a few localities have been found in which the use of the road machine has been continued for many years, and in such places the roads gradually deteriorate.

Road repairing is a very serious problem with many of the towns, especially in the western part of the State, where the expense is very high, on account of the lack of proper material. As there are many instances where the soil is generally hard-pan or clay, and there is an ample supply of field stone, the commission is of the opinion that stone crushers should be placed in the various counties, so that crushed stone may be used as a substitute for the otherwise poor materials.

The fact that in western Massachusetts many of the towns have declined in population and wealth, but still have as many or more miles of road to care for as formerly, renders the burden of maintaining their roads very heavy, if not actually insupportable. Roads have even been found in some of the towns on which there has been no repair work done for over fifteen years. The assistance of the Commonwealth accorded to these towns is therefore peculiarly acceptable, and, though small, as it must be under the law, it is heartily welcomed. As an indication of the appreciation of these towns of the benefit of this work, it may be said that with few exceptions they have very materially added to the State allotments by contributions of their own.

The commission is of the opinion that, on the whole, the "small town" act of 1900 has proved a wise one. Its general effect so far has been exceedingly beneficial to the smaller towns. It is not alone in the material aid given by the State to these towns that they may profit, but the officials acquire a practical knowledge of road building and repair which is felt indirectly on all the roads of the town where work is subsequently done by them. In other words, the commission is convinced that the practical education thus supplied will have a vast influence in producing better roads throughout the State. It may be said in this connection that the "small town" work has a more direct beneficial influence upon road men outside the cities and large towns than have the more expensive and elaborate State roads, which are much beyond the means of the ordinary country road maker. It may be added that in most cases where State aid has been given to towns it has been used in improvements to roads which will ultimately become parts of the State highway system; so that money thus paid out by the State will do a double service, in that a present need is satisfied, and the work so done will reduce the ultimate cost of State roads.

It is impossible for the commission to respond favorably to all petitions. Every petition must be considered on its merits, and although in general the commission believes that the applications which are received are worthy of allotments, yet some manifestly are not. At the present time 47 petitions are on file, upon which no action has been taken. Of these, a large proportion should receive favorable consideration. It is also probable that many more will be received before next year's allotments are made. It appears, therefore, that the five per cent. of the appropriation for the construction and repair of State highways set aside by the act each year will not be sufficient to do all of the work that the commission would approve. Under last year's amendment to the "small town" act, allowing the expenditure of a second five per cent. in towns of over $1,000,000 valuation, only one town has petitioned, showing either that the conditions attached to it are unpopular, or that the larger towns are not in need of the State's assistance. It may well be, however, that sufficient time has not yet elapsed since the passage of the act to give it a fair test. The amendments of last year have, without doubt, improved the original "small town" act.

STEAM ROAD ROLLERS.

The Commonwealth now owns 17 steam rollers, the purchase of which by the Highway Commission was authorized by various acts of the Legislature. These rollers are primarily for the use of towns of less than 12,000 population, although under certain conditions they may be used in the repair or construction of State roads. These rollers are very heavy. They are run long distances over rough and hilly country roads; loaded onto and unloaded from cars; subjected to rough usage in the heavy work which is required of them, and generally receive such treatment as to demand frequent repairs and the replacement of movable parts which are either lost or stolen. The commission has made a careful study of the problem, and is convinced that the most effective and economical way to care for these machines is to employ a good mechanic, who will not only make the necessary repairs, but will instruct the different roller men how to operate their rollers. Generally speaking, the men employed to run the rollers are well posted on stationary engines, but have little or no experience on machines subject to the varying conditions which are met with in this class of work. The result is that slight defects often develop into disablement, that is not only costly to remedy but is serious in the loss of time to the town using the roller.

These rollers were meant for the use of small towns, and it was the evident intent of the Legislature that the towns should pay for their maintenance and the cost of operating. As the law is framed at the present time, it is impossible for the commission to make an equitable distribution among the towns using the rollers of the cost of operation and maintenance. The commission would recommend that any money paid into the State treasury by the towns for the use or care of rollers be credited to the State highway fund, to be again used by the commission, instead of being credited to the State highway loan, as the Auditor rules has to be done under the law.

The steam rollers have been generally kept at work during the year, and the improvement in town roads as a result of their use is very marked. In the opinion of the commission, no one act of the Legislature has given a greater impetus to the good roads movement in the Commonwealth than the one authorizing the purchase of rollers.

ENGINEERING.

The engineering work of the commission has been conducted during the past year under the direction of Mr. Charles Mills, chief engineer, who has had charge of all the engineering and construction work.

Messrs. A. M. Lovis and S. A. Parsons, first and second assistant engineers, respectively, have had charge of the surveying parties and of the office work. Messrs. W. R. Farrington, J. A. Johnston, F. H. Joyner, F. C. Pillsbury and W. B. Wheeler, division engineers, have had charge of the construction work in the field. The list of resident engineers will be found in Appendix B.

Messrs. H. R. Starbird, D. W. Merrill, E. N. Colburn and F. M. Stuart have been employed as chiefs of survey parties, with Messrs. D. H. Dickinson, E. C. Hayden, N. B. Wilber and G. F. Whittemore as transitmen, and G. G. Bartlett, D. P. Clark, N. Maynard, A. S. Merrill, H. C. Miner, C. B. Hollis and R. E. Kimball as rodmen.

Messrs. J. H. Taylor, D. M. Hudson, C. R. Brown, W. G. Burns, A. Larrabee and C. F. Fitz have been employed in the draughting room as draughtsmen and computers. Mr. E. J. O'Hara has been employed as the chief engineer's stenographer.

Mr. Charles Mills, who had been employed as chief engineer of the commission since it began building State roads, resigned that position on the first day of December. The commission takes this occasion to express its appreciation of the engineering skill of Mr. Mills, and of the permanency of all the work done under his direction. The duties of the office were at all times exacting, and often exceedingly trying. On the resignation of the chief engineer the commission abolished the office, and the duties which were performed by that official will now devolve upon the secretary of the Board and the five division engineers.

Bridges begun and completed during the Year.

Two bridges have been built over the Weweantit River, the boundary line between the towns of Wareham and Marion. They are cast-iron pile bridges, with plank floors and brick surfaces, their spans being 106 feet and 80.5 feet, respectively. They were built jointly by the New Bedford & Onset Street Railway Company, the towns of Wareham and Marion and the Highway Commission.

In Williamsburg an old bridge over Mill River has been replaced by a plate-girder bridge having a span of 40 feet. By a change made in the channel of the river two old bridges were abolished, the material obtained from excavating for the new channel being used to fill the old river channel and also to raise the grade of the road.

In West Brookfield, Warren and Marshfield solid floor bridges, consisting of I-beams, brick and concrete arches and macadam surface, have been built, the spans being less than 30 feet.

In addition to the bridges described above, numerous culverts of various sizes have been constructed, to take care of surface water.

SURVEYS.

During the year surveys for preliminary studies, estimates and lay-outs have been made in 65 towns, a total length of 73 miles; and grade stakes for construction work have been set in 126 towns, representing a length of 92 miles, part of this being for work unfinished in 1900.

Final surveys have been made in 89 towns, the total length of such surveys being 55 miles. Surveys for "small town" work have been made in 36 towns, a total length of 30 miles; and about 20 miles of miscellaneous surveys have been made for roads to be constructed by towns.

OFFICE ENGINEERING WORK.

Plans, profiles and cross-sections have been plotted of surveys in 67 towns, representing a length of 73 miles. The plans and profiles were plotted on a horizontal scale of 40 feet to an inch, the vertical scale being 8 feet to an inch. The cross-sections were plotted on a natural scale of 4 feet to an inch.

Lay-out plans have been made of roads in 91 towns. Plans to accompany decrees for street railway locations on State highways and for provisional locations have been made in 28 towns; plans and profiles for work under the "small town" act in 33 towns; and miscellaneous plans, for 20 miles of road, have also been made.

Preliminary estimates in 104 towns, representing 68 miles, have been made, and also final estimates in 79 towns, representing 50 miles.

Bridge plans have been made as follows: —

Nine I-beam bridges, solid floor; spans, 12 to 28 feet.
One I-beam bridge, wooden floor; span, 22 feet.
One plate-girder bridge, solid floor; span, 40 feet.
One plate-girder bridge, wooden floor; span, 40 feet.
One cast-iron pile bridge, brick floor; span, 80.5 feet.
One cast-iron pile bridge, brick floor; span, 106 feet.

EXPENDITURES.

The following is a summary of the expenditures of the Highway Commission from Dec. 1, 1900, to Dec. 1, 1901: —

CONSTRUCTION EXPENDITURES.

TOWN OR CITY.	Year of Lay-out.	Amount.	Totals.
Barnstable County.			
Barnstable,	1901	$1,649 26	
Brewster (1st),	1901	3,030 13	
Brewster (2d),	1901	4,199 77	
Chatham,	1901	1,856 40	
Dennis (1st),	1900	325 22	
Dennis (2d),	1900	333 39	
Dennis,	1901	2,088 40	
Harwich (1st),	1900	151 78	
Harwich (2d),	1900	2,538 93	
Orleans,	1900	878 10	
Provincetown,	1901	796 32	
Sandwich,	1898	7 61	
Sandwich,	1900	4,301 72	
Truro (1900 contract),	1895	1,584 84	
Truro (1901 contract),	1895	904 99	
			$24,646 86
Berkshire County.			
Cheshire,	1901	$759 09	
Dalton,	1896	197 69	
Lee,	1900	9,377 33	
Lenox,	1899	108 65	
Lenox,	1900	1,203 59	
North Adams,	1900	4,958 70	
North Adams,	1901	4,857 20	
Pittsfield,	1901	3,323 80	
Richmond,	1901	2,639 77	
			27,425 82
Bristol County.			
Acushnet,	1901	$2,788 29	
Attleborough,	1900	1,059 74	
Attleborough,	1901	3,511 20	
Dartmouth,	1900	309 47	
Dartmouth,	1901	5,725 43	
Easton,	1900	1,598 59	
Mansfield,	1901	7 20	
Rehoboth,	1899	291 05	
Seekonk,	1900	3,460 90	
Seekonk,	1901	1,741 71	
Somerset,	1899	217 30	
Somerset,	1900	23 75	
Somerset,	1901	19 68	
Taunton,	1900	321 50	
Taunton,	1901	1,350 70	
			22,426 51
Amount carried forward,			$74,499 19

CONSTRUCTION EXPENDITURES — *Continued.*

TOWN OR CITY.	Year of Lay-out.	Amount.	Totals.
Amount brought forward,	. .	. . .	$74,499 19
Dukes County.			
Edgartown,	1900	$1,781 99	
Edgartown,	1901	2,063 11	
			3,845 10
Essex County.			
Amesbury,	1901	$4,901 87	
Groveland,	1900	5,616 14	
Hamilton,	1900	13 22	
Haverhill,	1899	12,565 29	
Lynn,	1897	3,526 85	
Merrimac,	1901	4,323 68	
Methuen,	1900	2,960 93	
Methuen,	1901	4,485 09	
Newbury,	1900	4,389 13	
Newbury,	1901	362 91	
North Andover,	1900	2,398 44	
Salem,	1901	1,731 21	
Saugus,	1898	376 65	
Saugus (bridges),	1898	76 05	
Swampscott,	1897	1,018 13	
Swampscott,	1900–01	5,692 22	
Wenham,	1901	4,277 47	
			58,715 28
Franklin County.			
Buckland,	1898	$7 06	
Buckland,	1900	1,829 61	
Colrain,	1901	1,161 51	
Deerfield,	1900	4,666 21	
Deerfield,	1901	2,497 73	
Erving,	1899	164 90	
Erving (1900 contract),	1900	108 65	
Erving (1901 contract),	1900	2,667 45	
Greenfield,	1900	3,111 25	
Montague,	1899	2,933 12	
Northfield,	1901	16 36	
Orange,	1900–01	5,178 00	
Whately,	1899	108 55	
Whately,	1901	3,586 95	
			28,037 45
Hampden County.			
Brimfield,	1901	$567 36	
Chester,	1900	172 16	
Chester,	1901	4,693 14	
Monson,	1901	1,063 65	
Palmer,	1900	111 10	
Palmer (1st),	1901	4,807 33	
Palmer (2d),	1901	4,845 06	
Wales,	1901	493 13	
Amounts carried forward,	. .	$16,752 83	$165,097 02

CONSTRUCTION EXPENDITURES — *Continued.*

TOWN OR CITY.	Year of Lay-out.	Amount.	Totals.
Amounts brought forward, . .	. .	$16,752 83	$165,097 02
Westfield, ...	1901	5,027 70	
Wilbraham (1st), ...	1901	1,527 00	
Wilbraham (2d),.	1901	24 15	
			23,331 68
Hampshire County.			
Amherst, ...	1901	$388 64	
Belchertown, ...	1900	4,686 96	
Belchertown, ...	1901	14 67	
Easthampton, ...	1900-01	5,201 29	
Hadley, ...	1899	521 52	
Hatfield, ...	1901	427 81	
Northampton, ...	1899	65	
Williamsburg, ...	1899	10 86	
Williamsburg, ...	1901	7,364 93	
			18,617 33
Middlesex County.			
Acton (Great Road), ...	1899	$24 58	
Acton (Great Road), ...	1900	1,135 04	
Acton (Great Road), ...	1901	5,052 58	
Acton (west), ...	1901	8,278 46	
Bedford, ...	–	1 43	
Chelmsford, ...	1901	4,424 47	
Concord, ...	1900	4,170 04	
Groton, ...	1901	37 76	
Lexington, ...	1900	1,943 61	
Marlborough, ...	1900	38 70	
Marlborough, ...	1901	5,108 57	
Natick,.	1901	6,181 27	
Newton, ...	1901	6,554 87	
North Reading, ...	1901	5,178 35	
Reading, ...	1900	1,593 19	
Stoneham, ...	1900	4,096 77	
Stoneham, ...	1901	2,787 24	
Sudbury, ...	1900	854 47	
Sudbury, ...	1901	7,642 85	
Tewksbury, ...	1900	117 21	
Tewksbury, ...	1901	2,132 56	
Townsend (1st), ...	1900	937 35	
Townsend (2d), ...	1900	1,705 52	
Townsend (1st contract), ...	1901	43 65	
Townsend (2d contract), ...	1901	1,240 62	
Wayland (1st), ...	1900	1,331 91	
Wayland (2d), ...	1900	4,486 12	
Winchester,.	1899	169 89	
Winchester,.	1900	16 42	
Woburn, ...	1900	1,555 93	
Woburn, ...	1901	2,372 07	
			81,213 50
Amount carried forward, . .	. .	. . . .	$288,259 53

CONSTRUCTION EXPENDITURES — *Continued.*

TOWN OR CITY.	Year of Lay-out.	Amount.	Totals.
Amount brought forward, . .	. .	. . .	$288,259 53
Nantucket County.			
Nantucket, ...	1899	$157 43	
Nantucket, ...	1900	1,342 21	
Nantucket, ...	1901	551 14	
			2,050 78
Norfolk County.			
Braintree, ...	1900	$4,688 04	
Cohasset, ...	1900	1,546 07	
Foxborough, ...	1901	3,141 68	
Milton, ...	1900	4,457 44	
Walpole, ...	1900	492 69	
Wellesley, ...	1901	6,433 56	
Weymouth, ...	1896	11 24	
Wrentham (1st), ...	1900	189 52	
Wrentham (2d), ...	1900	55 14	
Wrentham, ...	1901	4,549 00	
			25,564 38
Plymouth County.			
Abington (1st), ...	1900	$269 04	
Abington (2d), ...	1900	3,695 53	
Abington, ...	1901	4,851 75	
Brockton, ...	1900	765 72	
Lakeville, ...	1901	1,387 21	
Marion, ...	1899	149 19	
Marion (1st), ...	1901	902 42	
Marion (2d), ...	1901	1,993 02	
Marshfield, ...	1901	4,395 49	
Mattapoisett, ...	1900	1,064 47	
Mattapoisett, ...	1901	3,209 17	
Plymouth, ...	1896	118 97	
Scituate, ...	1900	993 52	
Wareham (1st), ...	1901	2,256 08	
Wareham (2d), ...	1901	2,109 53	
West Bridgewater, ...	1900	4,796 77	
West Bridgewater, ...	1901	2,571 75	
			35,529 63
Suffolk County.			
Chelsea, ...	1901	$8 48	
Revere, ...	1899	161 42	
Revere (bridges), ...	1899	32 60	
			202 50
Worcester County.			
Auburn, ...	1901	$2,040 77	
Barre, ...	1899	119 39	
Barre, ...	1900	4,571 64	
Barre, ...	–	5 70	
Blackstone, ...	1900	4,724 16	
Brookfield, ...	1900	161 64	
Amounts carried forward, . .	. .	$11,623 30	$351,606 82

CONSTRUCTION EXPENDITURES — *Concluded.*

TOWN OR CITY.	Year of Lay-out.	Amount.	Totals.
Amounts brought forward, . .	. .	$11,623 30	$351,606 82
Charlton, ...	1901	59 45	
Fitchburg, ...	1900	1,454 51	
Fitchburg, ...	1901	3,716 83	
Gardner, ...	1897	227 56	
Gardner, ...	1900	2,185 62	
Gardner, ...	1901	5,132 25	
Hardwick, ...	1901	4,167 02	
Harvard (1900 contract), . . .	1900	5,611 96	
Harvard (1901 contract), . . .	1900	2,859 66	
Holden, ...	1900	396 78	
Leicester, ...	1899	612 51	
Leominster, ...	1901	358 72	
Lunenburg, ...	1900	750 76	
Lunenburg, ...	1901	3,438 17	
Millbury, ...	1900	4,190 33	
Northborough, ...	1900	4,390 06	
Princeton, ...	1900	4,990 42	
Shrewsbury, ...	1899	243 31	
Shrewsbury, ...	1900	4,074 90	
Spencer, ...	1899	594 11	
Spencer (1st), ...	1900	1,746 38	
Spencer (2d), ...	1900	7,211 88	
Sutton, ...	1901	4,994 64	
Templeton, ...	1901	2,698 01	
Uxbridge, ...	1901	4,559 64	
Warren, ...	1899	2 35	
Warren, ...	1900	780 21	
Warren, ...	1901	4,944 18	
West Brookfield, ...	1900	22 57	
West Brookfield, ...	1901	8,975 42	
Worcester, ...	1900	5,206 10	
			102,219 61
Total, ...	. .	. . . .	$453,826 43

REPAIR AND MAINTENANCE EXPENDITURES.

TOWN OR CITY.	Amount.	Totals.
Barnstable County.		
Barnstable, ...	$198 10	
Bourne, ...	137 04	
Brewster, ...	215 18	
Chatham, ...	54 25	
Amount carried forward, ...	$604 57	

REPAIR AND MAINTENANCE EXPENDITURES — *Continued.*

TOWN OR CITY.	Amount.	Totals.
Amount brought forward,	$604 57	
Dennis,	387 80	
Harwich,	101 64	
Provincetown,	1 01	
Sandwich,	117 46	
Truro,	220 56	
Yarmouth (north),	241 97	
Yarmouth (south),	449 85	
Orleans,	32 59	
		$2,157 45
Berkshire County.		
Adams,	$152 45	
Cheshire,	151 53	
Dalton,	608 11	
Great Barrington,	671 03	
Hancock,	596 76	
Lee,	405 36	
Lenox,	682 73	
North Adams,	132 50	
Pittsfield,	560 12	
Richmond,	494 56	
Williamstown,	163 78	
Windsor,	1 33	
		4,620 26
Bristol County.		
Acushnet,	$180 37	
Attleborough,	4 69	
Dartmouth,	73 03	
Easton,	10 62	
Fairhaven,	176 35	
North Attleborough,	906 29	
Rehoboth,	39 77	
Seekonk,	2 65	
Somerset,	146 97	
Taunton,	59 55	
Westport,	826 48	
		2,426 77
Dukes County.		
Cottage City,	$465 70	
Edgartown,	62 92	
Tisbury,	113 96	
West Tisbury,	121 34	
		763 92
Essex County.		
Amesbury,	$137 61	
Andover,	188 47	
Beverly,	146 03	
Gloucester,	294 84	
Hamilton,	88 19	
Amounts carried forward,	$855 14	$9,968 40

Repair and Maintenance Expenditures — *Continued.*

TOWN OR CITY.	Amount.	Totals.
Amounts brought forward,	$855 14	$9,968 40
Haverhill,	16 53	
Lawrence,	1,184 14	
Merrimac,	166 34	
Methuen,	143 72	
Newbury,	45 56	
Newburyport,	123 58	
North Andover,	90 21	
Saugus,	346 33	
Swampscott,	61 14	
Wenham,	50 86	
West Newbury,	198 08	
		3,281 63
Franklin County.		
Ashfield,	$303 02	
Buckland,	358 24	
Charlemont,	180 21	
Colrain,	150 93	
Deerfield,	103 27	
Erving,	143 97	
Greenfield,	78 66	
Montague,	13 62	
Orange,	69 92	
Shelburne,	52 65	
Sunderland,	88	
Whately,	12 04	
		1,467 41
Hampden County.		
Brimfield,	$127 30	
Chester,	216 42	
Chicopee,	497 79	
Monson,	95 22	
Palmer,	138 30	
Russell,	938 83	
Westfield,	355 23	
West Springfield,	181 23	
Wilbraham,	34 06	
		2,584 38
Hampshire County.		
Belchertown,	$3 11	
Easthampton,	42 54	
Goshen,	53 81	
Granby,	55 06	
Hadley,	317 67	
Huntington,	412 32	
Northampton,	42 96	
South Hadley,	297 66	
Ware,	80 73	
Williamsburg,	80 48	
		1,386 34
Amount carried forward,	. . . .	$18,688 16

Repair and Maintenance Expenditures — *Continued*

TOWN OR CITY.	Amount.	Totals.
Amount brought forward,		$18,688 16
Middlesex County.		
Acton,	$53 60	
Ashby,	72 96	
Bedford,	25 29	
Boxborough,	36 62	
Chelmsford,	67 97	
Concord,	57 13	
Lexington,	125 93	
Lincoln,	72 84	
Lowell (north),	25 12	
Lowell (south),	1,455 10	
Marlborough,	126 51	
North Reading,	4 72	
Reading,	133 49	
Stoneham,	38 70	
Sudbury,	21 08	
Tewksbury,	23 30	
Townsend,	131 96	
Tyngsborough,	95 51	
Watertown,	214 14	
Wayland,	196 02	
Weston,	126 63	
Winchester,	340 64	
		3,445 26
Nantucket County.		
Nantucket,		237 90
Norfolk County.		
Braintree,	$2 14	
Cohasset,	33 50	
Holbrook,	35 98	
Milton,	1,210 34	
Norfolk,	33 91	
Norwood,	173 83	
Quincy,	22 41	
Walpole,	275 29	
Westwood,	75 28	
Weymouth,	123 99	
Wrentham,	148 97	
		2,135 64
Plymouth County.		
Abington,	$3 27	
Brockton,	92 53	
Duxbury,	128 40	
Hingham,	117 51	
Marion,	110 58	
Marshfield,	120 98	
Mattapoisett,	119 30	
Amounts carried forward,	$692 57	$24,506 96

REPAIR AND MAINTENANCE EXPENDITURES — *Concluded.*

TOWN OR CITY.	Amount.	Totals.
Amounts brought forward, ...	$692 57	$24,506 96
Middleborough, ...	71 76	
Plymouth, ...	546 05	
Scituate, ...	179 44	
Wareham, ...	26 48	
West Bridgewater, ...	4 64	
Whitman, ...	180 13	
		1,701 07
Suffolk County.		
Revere (east), ...	$139 64	
Revere (west), ...	752 05	
		891 69
Worcester County.		
Athol, ...	$38 01	
Auburn, ...	424 34	
Barre, ...	28 00	
Blackstone, ...	15 39	
Brookfield, ...	165 16	
Fitchburg, ...	81 60	
Gardner, ...	189 96	
Grafton, ...	236 05	
Hardwick, ...	36 72	
Harvard, ...	3 28	
Holden, ...	261 37	
Leicester, ...	379 16	
Lunenburg, ...	225 62	
New Braintree, ...	14 51	
Northborough, ...	123 03	
Paxton, ...	237 87	
Phillipston, ...	91 82	
Princeton, ...	4 64	
Shrewsbury, ...	368 45	
Spencer, ...	78 58	
Sterling, ...	161 05	
Sturbridge, ...	83 99	
Sutton, ...	69 56	
Templeton, ...	42 74	
Uxbridge, ...	147 96	
Warren, ...	150 29	
Westborough, ...	13 99	
West Boylston, ...	24 54	
West Brookfield, ...	32 35	
Westminster, ...	81 69	
Worcester, ...	150 03	
		3,961 75
Total, ...	. . . .	$31,061 47

Expended for repair and maintenance of steam road rollers, .	$429 82

EXPENDITURES UNDER "SMALL TOWN" ACTS.

[Under Chapter 432 of the Acts of 1900.]

Alford (two contracts),	$333 00	
Avon,	460 00	
Blandford,	900 00	
Bolton,	500 00	
Carver,	800 00	
Danvers,	3,000 00	
Halifax,	300 00	
Hanson,	1,200 00	
Lanesborough,	450 00	
Lakeville,	700 00	
Maynard,	750 00	
Mendon,	660 00	
Middlefield,	400 00	
Monterey,	300 00	
Mount Washington,	342 00	
New Marlborough,	600 00	
Otis,	400 00	
Pembroke,	864 00	
Rochester (two contracts),	3,000 00	
Sheffield,	1,000 00	
Stow,	448 00	
Tolland,	266 25	
Topsfield,	640 00	
Westford,	1,400 00	
West Stockbridge (two contracts),	1,090 00	
		$20,803 25

[Under Chapter 433 of the Acts of 1901.]

Westford,		966 30
		$21,769 55

GENERAL OFFICE EXPENSES, DEC. 1, 1900, to DEC. 1, 1901.

[Under Acts of 1900, Chapter 141.]

Salaries of commissioners,	$500 01
Travel of commissioners,	181 07
Salaries of clerical assistants and chief, first and second assistant engineers,	1,246 67
Printing, including postal cards and stamped envelopes,	35 35
Advertising hearings,	7 39
Office supplies,	55 70
Postage,	5 12
Amount carried forward,	$2,031 31

Amount brought forward,	$2,031 31	
Examining titles,	15 00	
Expenses in Graves-Brown case, Swampscott,	8 00	
Miscellaneous items,	6 02	
		$2,060 33

[Under Acts of 1901, Chapter 511.]

Salaries of commissioners,	$7,791 65	
Travel of commissioners,	1,609 95	
Salaries of clerical assistants and chief, first and second assistant engineers,	13,700 32	
Rent of offices,	3,760 42	
Printing, including postal cards and stamped envelopes,	1,292 08	
Advertising hearings,	53 73	
Office supplies,	319 17	
Telephone, including tolls,	164 59	
Postage,	169 48	
Examining titles,	79 80	
Recording land takings and easements,	25 22	
Expenses in Isaac C. Wyman case, Swampscott,	115 25	
Expenses in H. B. Taylor case, Plymouth,	41 10	
Miscellaneous items, including telegraph and express charges, car fares and minor office expenses,	330 46	
		29,453 22
		$31,513 55

SUMMARY OF EXPENDITURES.

For construction,	$453,826 43
For road repair and maintenance,	31,061 47
For steam roller repair and maintenance,	429 82
For construction under "small town" acts,	21,769 55
For general office accounts,	31,513 55
Total expenditures for year,	$538,600 82

W. E. McCLINTOCK.
HAROLD PARKER.
JOHN H. MANNING.

APPENDIX.

APPENDIX A.

TABLE SHOWING THE HIGHWAYS LAID OUT, CONSTRUCTED OR CONTRACTED TIONS TO

[In the last column, the capital letters used have the following significance: A, trap; B, local E, limestone; F, gravel; G, gravel and four-inch macadam; H, screened gravel; K, clay and

	TOWN.	Year.	ROAD LAID OUT.
			From —
1	Abington,	1900,	Brockton line,
2	Abington,	1901,	End of 1900 lay-out,
3	Acton,	1899-1900,	Concord line,[1]
4	Acton,	1901,	End of 1900 lay-out,
5	Acton (west),	1901,	Boxborough line,
6	Acushnet,	1897,	1,500 feet east of New Bedford line,
7	Acushnet,	1901,	Long Plain village,
8	Adams,	1897,	Cheshire line,
9	Amesbury,	1899,	Merrimac line,
10	Amesbury,	1901,	End of 1899 lay-out,
11	Amherst,	1901,	Hadley line,
12	Andover,	1895-96,	Lawrence line,
13	Andover,	1897-99-1900,	North Reading line,
14	Ashby,	1894-98-99,	Ashby post-office,
15	Ashfield,	1897-98,	One mile north of Ashfield post-office,
16	Athol,	1895-96,	Orange line,
17	Attleborough,	1900,	North Attleborough line,
18	Attleborough,	1901,	End of 1900 lay-out,
19	Auburn,	1895-97,	Dunn's Mills,
20	Auburn,	1898-99,	Worcester line,
21	Auburn,	1901,	End of 1897 lay-out,
22	Barnstable (north),	1899,	Sandwich line,
23	Barnstable (south),	1897,	Yarmouth line,
24	Barnstable (south),	1901,	End of 1897 lay-out,
25	Barre,	1897-99-1900,	Bridge over Ware River,
26	Bedford,	1897,	Lexington line,
27	Belchertown,	1900,	Near depot,

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[1] Exclusive of 1,100 feet at railroad crossing.

APPENDIX A.

FOR BY THE COMMISSION, AND THE NATURE OF THE SEVERAL CONSTRUC-
JAN. 1, 1902.

field stone; C, local ledge other than trap; D, bottom course local field stone, top course trap; four-inch macadam; M, clay and screened gravel; N, unsurfaced.]

ROAD LAID OUT.		Length Con-structed.	WIDTHS.			Material of Road Surface.	
Direction.	Length		Location.	Macadam.	Shoulders.		
	Miles.	Miles.	Feet.	Feet.	Feet.		
Easterly, . .	.70	.58	50	15	3	B.	1
Easterly, . .	.48	.65	60	15	-	B.	2
Northerly, . .	2.78	2.78	50+	15	3	A-G.	3
North-westerly, .	.64	.53	50	15	-	A-G.	4
South-easterly, .	.72	.72	60	15	-	A.	5
Northerly, . .	.63	.63	50+	15	3	B.	6
To Rochester line,	1.77	1.77	40	15	-	B.	7
Northerly, . .	.57	.57	50	15	3	A.	8
Easterly, . .	.51	.38	50-60	15	3	B.	9
Easterly, . .	.43	.56	60-55	15	-	B.	10
Easterly, . .	.95	Partly graded.	50	15	-	A.	11
Southerly, . .	1.22	1.22	66	18	3	D.	12
Northerly, . .	1.85	1.85	60	15	3	C.	13
Southerly, . .	3.58	3.58	66-50	20-18-15	5-3	B.	14
Northerly, . .	1.61	1.61	50-70	-	-	H.	15
Easterly, . .	1.61	1.61	50	17	3	D-A.	16
South-westerly, .	1.00	1.00	66	15	3	F.	17
South-westerly, .	1.20	1.20	66	-	-	F.	18
Southerly, . .	1.93	1.93	50	15	3	'95 A, '96-7 B.	19
Southerly, . .	1.14	1.14	50+	15-18	3	A.	20
South-westerly, .	.98	.75	50+	-	-	N.	21
South-easterly, .	.95	.95	50	15	-	B.	22
Westerly, . .	.85	.85	40+	18-15	3	B.	23
Westerly, . .	1.41	1.41	40-62	15	-	B.	24
North-westerly, .	1.63	1.63	50-49.5	15	3	A.	25
North-westerly, .	.54	.54	50	15	3	B.	26
South-westerly, .	.66	.66	50	15	3	A-G.	27

TABLE SHOWING THE HIGHWAYS LAID OUT, CONSTRUCTED OR

	TOWN.	Year.	ROAD LAID OUT.
			From —
1	Belchertown,	1901,	End of 1900 lay-out,
2	Beverly,	1895-97-98,	Wenham line,
3	Blackstone,	1899-1900,	Uxbridge line,
4	Bourne,	1897-98,	Cohasset Narrows,
5	Boxborough,	1897-99,	Acton line,
6	Braintree,	1900,	Quincy line,
7	Brewster,	1895-97,	Dennis line,
8	Brewster,	1901,	End of 1897 lay-out,
9	Brimfield,[1]	1897-99,	Monson line,
10	Brimfield,	1901,	Wales line,
11	Brockton,	1897-98-99,	Easton line,
12	Brockton,	1900,	Abington line,
13	Brookfield,	1897-98-1900,	Mill Street,
14	Buckland,	1894-1900,	Shelburne Falls station,
15	Charlemont,	1897-98-99,	Bridge over Deerfield River,
16	Charlton,	1901,	Charlton Depot village,
17	Chatham,	1899,	Depot Street,
18	Chatham,	1901,	End of 1899 lay-out,
19	Chelmsford,	1898-99,	Lowell line,
20	Chelmsford,	1901,	906 feet from the end of 1899 lay-out,
21	Chelsea,	1901,	Willoughby Street,
22	Cheshire,	1899-1900,	Farnham station, Boston & Albany Railroad.
23	Cheshire,	1901,	1,000 feet north of 1900 lay-out,
24	Chester,	1899-1900,	100 feet from Becket line,
25	Chester,	1901,	End of 1900 lay-out,
26	Chicopee,	1897-99,	Springfield line,
27	Cohasset,	1897-99-1900,	Near Hingham line,
28	Colrain,	1898,	Shelburne line,
29	Colrain,	1901,	End of 1898 lay-out,
30	Concord,	1897-98,	Lincoln line,
31	Concord,	1900,	Acton line,
32	Cottage City,	1894-96,	Sengekontacket bridge,
33	Dalton,	1895-96,	Pittsfield line,
34	Dartmouth,	1898-99-1900,	Westport line,
35	Dartmouth,	1901,	End of 1900 lay-out,
36	Deerfield,	1894-95,	South Deerfield station,

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[1] Exclusive of 200 feet at bridge at Foskett's Mills.

CONTRACTED FOR BY THE COMMISSION, ETC. — *Continued.*

ROAD LAID OUT.		Length Constructed.	WIDTHS.			Material of Road Surface.	
Direction.	Length.		Location.	Macadam.	Shoulders.		
	Miles.	Miles.	Feet.	Feet.	Feet.		
South-westerly, .	.60	-	50	15	-	A-G.	1
Southerly, . .	2.01	2.01	50-60	18	3	'95-7 A, '98 C.	2
South-easterly, .	1.17	1.17	49.5-50+	15	3	A-G.	3
Easterly, . .	1.42	1.42	45+	15	3	B-C.	4
Westerly, . .	1.36	1.36	60-50	15	4-3	B.	5
South-easterly, .	.46	.46	66	18	3	A.	6
Easterly, . .	2.49	2.49	40-50	15	3	B.	7
To Orleans line, .	5.30	5.30	50+	15	-	B.	8
Southerly, . .	2.34	2.34	60-50	-	-	'99 F, '97 H.	9
Northerly, . .	1.19	Partly graded.	50	-	-	N.	10
Easterly, . .	1.87	1.87	33	16	3.5	B.	11
Westerly, . .	.66	.66	50	15	3	B.	12
Easterly, . .	1.39	1.39	50	15	3	A.	13
Westerly, . .	3.49	3.49	30-50	24-18-15-12	3	A-C.	14
Easterly, . .	.77	.77	50-42+	15	3	D.	15
Southerly, . .	1.10	Partly graded.	50	15	-	B.	16
North-westerly, .	.59	.59	50	15-12	-	A.	17
North-westerly, .	.68	.68	50	15	-	A.	18
Westerly, . .	.93	.93	50	18	3	A.	19
North-westerly, .	.51	.50	50	15	-	A.	20
Southerly, . .	.58	.30	66	24	-	A.	21
North-easterly, .	1.42	1.42	50	15	-	G-A.	22
North-easterly, .	.46	-	50	-	-	N.	23
North-easterly, .	.66	.66	50	15	3	A.	24
Easterly, . .	.48	.48	40-50	15	-	A.	25
Northerly, . .	.92	.92	55-50-60	20	4-3	A.	26
Easterly, . .	1.73	1.73	50-50+	15	3	B-D.	27
Northerly, . .	1.08	1.08	40-50	-	-	H.	28
Northerly, . .	.75	.49	50+	-	-	H.	29
North-westerly, .	1.47	1.47	50	15	3	B.	30
South-westerly, .	.52	.52	50	15	3	G-A.	31
Northerly, . .	2.37	2.37	50	15	3	B.	32
Easterly, . .	1.56	1.56	30-60	15	7.5	A.	33
Easterly, . .	2.22	2.22	30	18	3	B.	34
Easterly, . .	.46	.46	30	18	-	B.	35
South-easterly, .	1.53	1.53	30	15	3	A.	36

TABLE SHOWING THE HIGHWAYS LAID OUT, CONSTRUCTED OR

	TOWN.	Year.	ROAD LAID OUT.
			From —
1	Deerfield,	1900,	Cheapside bridge,
2	Deerfield,	1901,	End of 1900 lay-out,
3	Dennis,	1895-98,	Yarmouth line,
4	Dennis (south),	1900,	Bass River bridge,
5	Dennis (south),	1901,	End of 1900 lay-out,
6	Duxbury,	1894-95-97-99,	Marshfield line,
7	Easton,	1900,	Brockton line,
8	Easthampton,	1895-96,	Northampton line,
9	Easthampton,	1900,	Clark Street,
10	Easthampton,	1901,	End of 1900 lay-out,
11	Edgartown,	1897-99-1900,	Sengekontacket bridge,
12	Edgartown,	1901,	End of 1900 lay-out,
13	Erving,	1898-99-1900,	Town hall to Orange line,
14	Fairhaven,	1894-95,	Mattapoisett line,
15	Fitchburg,	1894-95,	Westminster line,
16	Fitchburg,	1897,	Lunenburg line,
17	Fitchburg,	1900,	Ashby line,
18	Fitchburg,	1901,	End of 1900 lay-out,
19	Foxborough,	1901,	Mansfield line,
20	Gardner,	1897-98,	Templeton line,
21	Gardner,	1900,	Westminster line,
22	Gardner,	1901,	End of 1900 lay-out,
23	Gloucester,	1894-95-98,	Manchester line,
24	Goshen,	1894-95,	Goshen village to Williamsburg line,
25	Grafton,	1897-99-1900,	Millbury line,
26	Granby,	1894,	South Hadley line,
27	Great Barrington,	1894-96-97,	Housatonic River,
28	Greenfield,	1899,	225 feet north-west of Boston & Maine bridge, near Deerfield line.
29	Greenfield,	1900,	500 feet from beginning of 1899 lay-out,
30	Groton,	1901,	Near Nashua River,
31	Groveland,	1900,	King Street,
32	Groveland,	1901,	End of 1900 lay-out,
33	Hadley,	1894-98-99-1900,	Connecticut River bridge,
34	Hamilton,	1899-1900,	2 miles north from Wenham line,
35	Hancock,	1895-96-98-99,	Pittsfield line,
36	Hardwick,	1897,	New Braintree line,

CONTRACTED FOR BY THE COMMISSION, ETC.— *Continued.*

ROAD LAID OUT.		Length Constructed.	WIDTHS.			Material of Road Surface.	
Direction.	Length.		Location.	Macadam.	Shoulders.		
	Miles.	Miles.	Feet.	Feet.	Feet.		
South-westerly, .	.44	.44	50	15	3	A.	1
Southerly, . .	.37	.37	50	15	-	A.	2
North-easterly, .	4.27	4.27	40-50-66	15	3	B.	3
Easterly, . .	1.00	1.00	40	15	3	A.	4
Easterly, . .	.31	.31	40-45	15	-	A.	5
Southerly, . .	2.05	2.05	30-40-50	15	3	A-B-C.	6
South-westerly, .	.80	.80	70	15	3	B-G.	7
South-westerly, .	1.32	1.32	40	15	3	A.	8
Southerly, . .	.79	.79	50	15	3	A.	9
Southerly, . .	.31	.31	49.5	15	3	A.	10
Southerly, . .	1.01	1.01	50	15	3	B.	11
South-easterly, .	.52	.52	50	15	-	B.	12
Easterly, . .	2.04	2.04	50-50+	-	-	F.	13
Westerly, . .	1.45	1.45	30	15	3	B.	14
Easterly, . .	.97	.97	50	15	3	A.	15
Westerly, . .	.61	.61	50	18-15	3	D.	16
Southerly, . .	.58	.58	50	15	3	B.	17
Southerly, . .	.49	.49	50	15	-	B.	18
Northerly, . .	.97	.84	50	15	-	B-G.	19
Easterly, . .	2.37	2.37	50+	15	-	A-G.	20
Westerly, . .	.62	.29	60	-	-	A.	21
North-westerly, .	.36	.31	60	15	-	A.	22
North-easterly, .	2.48	2.48	50	15	3	C-B.	23
South-easterly, .	1.91	1.91	50	15	3	B.	24
South-easterly, .	1.56	1.56	50	15	3	G-A-B.	25
North-easterly, .	.63	.63	36	15	3	A.	26
Easterly, . .	2.79	2.79	40-50-70	18-15	3	'94 A, '96-7 F.	27
North-westerly, .	.59	.59	49.5-50	18	-	A.	28
Easterly, . .	.40	.40	50	15	3	A.	29
South-easterly, .	.54	Partly graded.	50	15	-	A.	30
North-easterly, .	.56	.56	50	15	3	A.	31
North-easterly, .	.21	-	50	15	-	A.	32
Easterly, . .	2.93	2.73	50-82.5-66+	15	3	A.	33
North-easterly, .	1.44	1.44	60-50	15	3	B.	34
Westerly, . .	3.23	3.23	50	-	-	F.	35
Northerly, . .	.39	.39	50	15	3	A.	36

TABLE SHOWING THE HIGHWAYS LAID OUT, CONSTRUCTED OR

	TOWN.	Year.	ROAD LAID OUT.
			From —
1	Hardwick,	1901,	End of 1897 lay-out,
2	Harvard,	1900,	Woodchuck hill,
3	Harwich,	1899-1900,	Dennis line,
4	Harwich,	1901,	End of 1900 lay-out,
5	Hatfield,	1901,	Northampton line,
6	Haverhill,	1899,	West end of River Street,
7	Hingham,	1894,	Weymouth Back River,
8	Hingham,	1896-97,	Near Cohasset line,
9	Hinsdale,	1901,	Dalton line,
10	Holbrook,	1894-96,	Weymouth line,
11	Holden,	1894-97,	1894-96, Holden village, 1897, end of 1894 lay-out,
12	Holden,	1898-1900,	Worcester line,
13	Huntington,	1895-96,	Russell line,
14	Lakeville,	1901,	⅛ mile from Middleborough line,
15	Lawrence,	1896,	Methuen line,
16	Lee,	1894-96,	Lee Park,
17	Lee,	1900,	Lenox line,
18	Leicester,	1894-95-96-98-99,	Worcester line,
19	Lenox,	1899-1900,	Lee line,
20	Lenox,	1901,	End of 1899 lay-out,
21	Leominster,	1901,	Near comb shop,
22	Lexington,	1895-98,	Massachusetts Avenue,
23	Lexington,	1900,	Bedford line,
24	Lincoln,	1895-97,	Concord line to Lexington line,
25	Lowell (Boulevard),	1897,	Tyngsborough line,
26	Lowell (Princeton Street),	1897-98,	Chelmsford line,
27	Lunenburg,	1898-99-1900,	Fitchburg line,
28	Lunenburg,	1901,	End of 1900 lay-out,
29	Lynn,	1899,	264 feet north of centre of channel of Saugus River and Revere line.
30	Mansfield,	1901,	Foxborough line,
31	Marion,	1894-95,	Marion village,
32	Marion,	1897-1899,	Marion village,
33	Marion,	1901,	End of 1899 lay-out,
34	Marion (Wareham),	1901,	End of 1895 lay-out,
35	Marlborough (east),	1897,	Sudbury line,
36	Marlborough (west),	1897-99-1900,	Northborough line,

CONTRACTED FOR BY THE COMMISSION, ETC. — *Continued.*

Road Laid Out.		Length Constructed.	Widths.			Material of Road Surface.	
Direction.	Length.		Location.	Macadam.	Shoulders.		
	Miles.	Miles.	Feet.	Feet.	Feet.		
North-easterly, .	.43	.43	50	15	-	A.	1
Westerly, . .	.70	.66	60	15	-	B.	2
Easterly, . .	2.15	2.15	40+	15	-	A.	3
Easterly, . .	.38	.38	40	15	-	A.	4
North-easterly, .	.89	Partly graded.	50	15	-	A.	5
Westerly, . .	2.08	2.08	70	-	-	F.	6
Easterly, . .	1.42	1.42	34	-	-	F.	7
Westerly, . .	1.23	1.23	50-33+	15	3	D.	8
South-easterly, .	.40	-	50	-	-	-	9
Westerly, . .	1.11	1.11	50	15	3	B-C.	10
Northerly, } Southerly, } .	2.70	2.70	30-49.5	18-15	3	B.	11
Northerly, . .	1.06	1.06	50	15	3-5	B.	12
Westerly, . .	1.01	1.01	50+	15	3	A.	13
South-westerly, .	1.97	.85	50	15	-	B.	14
Southerly, . .	.27	.27	50	18	7	C.	15
Easterly, . .	1.98	1.98	40-35-50	24-15	3	D.	16
Southerly, . .	1.26	1.26	50	15	3	D.	17
Westerly, . .	4.87	4.87	39-53-55-67+	24-18-16-15	3-5-5.5	'94-6 D, '98-9 B.	18
Northerly, . .	1.21	1.21	56±	15	3	D.	19
Northerly, . .	1.07	1.07	60-66	15	3	D.	20
South-westerly, .	1.82	Partly graded.	50	-	-	F.	21
Westerly, . .	3.45	3.45	50-50+	15	3	B.	22
South-easterly, .	.85	.85	50	15	3	B.	23
South-easterly, .	2.07	2.07	50	15	3	B.	24
Easterly, . .	.97	.97	60	15	3	D.	25
Easterly, . .	1.34	1.34	50±	18	6	D.	26
Easterly, . .	1.45	1.45	50	15	3	D.	27
Easterly, . .	.40	.40	50	15	-	D.	28
North-easterly, .	.90	-	70	-	-	-	29
South-easterly, .	.72	Partly graded.	50	15	-	B-G.	30
North-easterly, .	1.48	1.48	40	15	3	B.	31
Westerly, . .	1.38	1.38	40-55	15	3	B.	32
South-westerly, .	.30	.35	50	15	-	B.	33
To Wareham line,	.10	Partly graded.	50-65	-	-	-	34
Westerly, . .	.40	.40	50-60	15	3	B.	35
Easterly, . .	1.71	1.71	50	15	5-4-3	B.	36

Table showing the Highways laid out, constructed or

	TOWN.	Year.	Road Laid Out.
			From —
1	Marlborough,	1901,	End of 1900 lay-out,
2	Marshfield,	1894-96-98-99,	Duxbury line,
3	Marshfield,	1901,	End of 1899 lay-out,
4	Mattapoisett,	1894-95,	Fairhaven line,
5	Mattapoisett,	1900,	Ned Point Light road,
6	Mattapoisett,	1901,	End of 1900 lay-out,
7	Merrimac,	1897-98-99,	Near Haverhill line,
8	Merrimac,	1901,	Amesbury line,
9	Methuen,	1896-1900,	Lawrence line,
10	Methuen,	1901,	End of 1900 lay-out,
11	Middleborough,	1894-98,	Nemasket River,
12	Millbury,	1900,	Worcester line,
13	Milton,	1899-1900,	Neponset River,
14	Monson,	1894,	Railroad bridge,
15	Monson,	1901,	Palmer line,
16	Montague,	1898-99,	Junction pipe line and ferry road, East,
17	Nantucket,	1894-95-96-97-98-99-1900.	First mile-stone,
18	Nantucket,	1896,	Seventh mile-stone,
19	Nantucket,	1901,	End of 1900 lay-out,
20	Natick,	1901,	Wellesley line,
21	Needham,	1901,	Newton line,
22	New Braintree,	1897,	Hardwick line to Ware line,
23	Newbury,	1899-1900,	Newburyport line,
24	Newbury,	1901,	End of 1900 lay-out,
25	Newburyport,	1896-98,	West Newbury line,
26	Newton,	1901,	Needham line,
27	Norfolk,	1895,	Walpole line to Wrentham line,
28	North Adams,	1894-96-97,	Williamstown line,
29	North Adams,	1900,	Boston & Maine Railroad bridge at Davenport Street.
30	North Adams,	1901,	End of 1900 lay-out,
31	Northfield,	1901,	Near Mill Brook,
32	Northampton,	1894,	Hadley Bridge,
33	Northampton,	1897-99-1900,	Easthampton line,
34	Northampton,	1898-99,	South Street, end city macadam,
35	North Andover,	1900,	Lawrence line,
36	North Andover,	1901,	End of 1900 lay-out,

CONTRACTED FOR BY THE COMMISSION, ETC. — *Continued.*

Road Laid Out.		Length Constructed.	Widths.			Material of Road Surface.	
Direction.	Length.		Location.	Macadam.	Shoulders.		
	Miles.	Miles.	Feet.	Feet.	Feet.		
Easterly, . .	.70	.30	50-65	15	-	B.	1
Northerly, . .	2.00	2.00	30-40-45	15	3	B-C.	2
Northerly, . .	.41	.41	45	15	-	B-C.	3
Easterly, . .	1.16	1.16	30	15	3	B.	4
Easterly, . .	.81	.81	40	15	3	B.	5
Easterly, . .	.57	.50	50	15	-	B.	6
North-easterly, .	.92	.92	50+	15	4-3	B-C.	7
South-westerly, .	.64	.64	50	15	3	C.	8
North-easterly, .	1.67	1.67	50-50+	15	3	C-B.	9
North-easterly, .	.52	.49	50	15	-	C.	10
Southerly, . .	2.76	2.76	30-50	15	7.5-3	B.	11
Southerly, . .	.38	.38	50	15	3	A.	12
South-easterly, .	.87	.87	49.5-82.5	24	4	A.	13
Northerly, . .	.93	.93	33	15	3	A.	14
South-easterly, .	.10	.10	50	15	-	A.	15
North-westerly, . .	1.63	1.63	60	15	3	A.	16
Easterly, . .	4.51	4.51	66	12-15	3	B-E-G.	17
Westerly, . .	.66	.66	66	15	3	B-G.	18
Easterly, . .	.71	.17	66	12	-	B-G.	19
Westerly, . .	1.14	1.14	60-70	15-18-20	-	A-G.	20
Westerly, . .	1.00	-	60-86	18-22	-	B.	21
Southerly, . .	.17	.17	50	15	3	A.	22
Southerly, . .	1.22	1.22	66-95	15	3	B.	23
Southerly, . .	.88	Partly graded.	66-80	15	-	B.	24
Easterly, . .	1.75	1.75	60-60+-75+	15	3	C.	25
North-easterly, .	1.03	1.03	45-86	22	-	A.	26
South-westerly, .	1.45	1.45	50	15	3	B.	27
Easterly, . .	1.69	1.69	30-66	15	3	D.	28
South-easterly, .	.54	.54	50	15	3	A.	29
Southerly, . .	.47	.47	50	15	-	A.	30
Southerly, . .	.63	-	70-160	15	-	B.	31
South-westerly, .	.56	.56	40	20	3	C.	32
Northerly, . .	.64	.64	50	15	3	A.	33
Southerly, . .	.48	.48	50	15	3	A.	34
South-easterly, .	.79	.79	66	15	3	D.	35
South-easterly, .	.57	-	60-66	15	-	A.	36

TABLE SHOWING THE HIGHWAYS LAID OUT, CONSTRUCTED OR

	TOWN.	Year.	ROAD LAID OUT.
			From —
1	North Attleborough,	1894-97-99,	Bruce Avenue,
2	Northborough (east),	1897-98,	Marlborough line,
3	Northborough (south),	1897,	Westborough line,
4	Northborough (west),	1900,	Shrewsbury line,
5	North Reading,	1897-98,	Andover line,
6	North Reading,	1901,	End of 1898 lay-out,
7	Norwood,	1895-96,	Ellis station,
8	Norwood,	1897-99,	Walpole line,
9	Orange,	1894-95-97,	Athol line,
10	Orange,	1900,	Erving line,
11	Orange,	1901,	End of 1900 lay-out,
12	Orleans,	1900,	Brewster line,
13	Orleans,	1901,	End of 1900 lay-out,
14	Palmer,	1899-1900,	Tenneyville, near Boston & Albany Railroad freight station.
15	Palmer,	1901,	End of 1900 lay-out,
16	Paxton,	1895-98,	Worcester line,
17	Phillipston,	1897-98,	Near Athol line,
18	Pittsfield,	1894-98,	Hancock line,
19	Pittsfield,	1897,	Dalton line,
20	Pittsfield,	1901,	End of 1898 lay-out,
21	Plymouth,	1894-98,	Beaver Dam Brook,
22	Princeton,	1897-1900,	Princeton station,
23	Provincetown,	1901,	Near Truro line,
24	Quincy,	1899,	Near Weymouth Fore River bridge,
25	Raynham,	1901,	Taunton line,
26	Reading,	1899-1900,	Stoneham line,
27	Rehoboth,	1895-96-99,	Seekonk line,
28	Revere,	1897-98,	Boston line,
29	Revere,	1899,	Saugus line,
30	Richmond,	1897-98-99,	Boston & Albany Railroad station,
31	Richmond,	1901,	End of 1899 lay-out,
32	Russell,	1894-96-97-98-99,	Westfield line to Huntington line,
33	Salem,	1901,	Swampscott line,
34	Sandwich,	1897-98-1900,	Barnstable line,
35	Saugus,	1899,	Fox Hill bridge to Revere line,
36	Scituate,	1894-95-1900,	Gannett's Corners,

CONTRACTED FOR BY THE COMMISSION, ETC. — *Continued.*

ROAD LAID OUT.		Length Constructed.	WIDTHS.			Material of Road Surface.	
Direction.	Length.		Location.	Macadam.	Shoulders.		
	Miles.	Miles.	Feet.	Feet.	Feet.		
South-westerly, .	3.60	3.60	36-66	24-18-15	3	'94-'95 B, '96-'97-'99 F.	1
South-westerly, .	1.33	1.33	66	15	4-3	B.	2
North-westerly, .	.42	.42	50	15	3	B.	3
Easterly, . .	.42	.42	66	15	3	B.	4
Southerly, . .	1.01	1.01	66	15	3	C.	5
Southerly, . .	.75	.75	66	15	-	B.	6
Southerly, . .	1.02	1.02	40-50-67	15	3	B.	7
Northerly, . .	1.03	1.03	45-50-60	15	3	B.	8
Westerly, . .	2.18	2.18	30-49.5	17	3-5	D-A.	9
Easterly, . .	.42	.42	50	15	3	B.	10
Easterly, . .	.41	.41	50	15	-	B.	11
North-easterly, .	.82	.82	50	15	3	B.	12
North-easterly, .	.42	-	50	-	-	-	13
South-easterly, .	1.58	1.58	50+	15	3	G-A.	14
Easterly, . .	.93	.93	50+	15	3	G-A.	15
North-westerly, .	3.24	3.24	50-70	15	3-5	B.	16
Easterly, . .	1.19	1.19	50	15-12	4-3	B.	17
Easterly, . .	1.54	1.54	60-50-40	15	3	A.	18
Westerly, . .	.76	.76	50	-	-	F.	19
North-easterly, .	.37	.33	60	15	-	A.	20
Southerly and northerly.	3.86	3.86	40-50-112	15	3	B.	21
Easterly, . .	.99	.99	50	15	3	B.	22
Westerly, . .	.22	.22	33	15	-	B.	23
North-westerly, .	.49	.50	63-66	32	-	A.	24
North-easterly, .	.61	-	40	15	-	A.	25
Northerly, . .	1.07	1.07	66	15-18	3	B.	26
Easterly, . .	1.89	1.89	60	15	3	B.	27
North-easterly, .	.58	.58	44-50	24	3	A.	28
South-westerly, .	.67	.67	71	22	2	A.	29
Northerly, . .	1.36	1.36	66	-	-	F.	30
North-easterly, .	.24	.41	66	-	-	F.	31
North-westerly, .	6.66	6.66	50	15	3	'94-'95 A, '96-'97-'98-'99 F.	32
Northerly, . .	.13	.13	60+	-	-	F.	33
Westerly, . .	2.57	2.57	50	15	3	B.	34
Southerly, . .	1.60	1.60	71±	22	2	A.	35
South-easterly, .	1.77	1.77	40-50-30	15	3	A-B-C.	36

TABLE SHOWING THE HIGHWAYS LAID OUT, CONSTRUCTED OR

	TOWN.	Year.	ROAD LAID OUT.
			From —
1	Shelburne,	1894-97,	Bridge Street,
2	Seekonk,	1900,	Rehoboth line,
3	Seekonk,	1901,	End of 1900 lay-out,
4	Shrewsbury,	1895-98-99-1900,	Worcester line,
5	Somerset,	1895-97-99-1900,	South Street,
6	Somerset,	1901,	End of 1895 lay-out,
7	South Hadley,	1895-97-98-99-1900,	Granby line,
8	Spencer,	1897-1900,	Leicester line,
9	Spencer,	1901,	End of 1900 lay-out,
10	Sterling,	1897-98,	Near town hall,
11	Stoneham,	1897-98,	South Street,
12	Stoneham,	1900,	Reading line,
13	Stoneham,	1901,	End of 1900 lay-out,
14	Sturbridge,	1897,	Fisk Hill road,
15	Sudbury,	1897-98-1900,	Marlborough line,
16	Sudbury,	1901,	End of 1900 lay-out,
17	Sudbury,	1901,	Wayland line,
18	Sunderland,	1897,	Connecticut River bridge,
19	Sutton,	1899,	Millbury line,
20	Sutton,	1901,	End of 1899 lay-out,
21	Swampscott,	1897,	Boston & Maine Railroad (Swampscott branch).
22	Swampscott,	1900,	End of 1897 lay-out,
23	Swampscott,	1901,	End of 1900 lay-out,
24	Taunton,	1895-96-98-99-1900,	Near Highland Street,
25	Taunton,	1901,	End of 1900 lay-out to Dighton line,
26	Templeton,	1899,	Gardner line,
27	Templeton,	1901,	End of 1899 lay-out,
28	Tewksbury,[1]	1900,	Lowell line,
29	Tewksbury,	1901,	End of 1900 lay-out,
30	Tisbury,	1894,	Vineyard Haven village,
31	Townsend,	1896-98-99-1900,	Townsend village,
32	Townsend,	1901,	End of 1900 lay-out to Groton line,
33	Truro,	1895,	Wellfleet line,
34	Tyngsborough,	1895-96,	Tyngsborough bridge to Lowell line,
35	Uxbridge,	1897-98,	Blackstone line,

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[1] Exclusive of 1,200 feet at railroad crossing.

CONTRACTED FOR BY THE COMMISSION, ETC. — *Continued.*

Road Laid Out.		Length Constructed.	Widths.			Material of Road Surface.	
Direction.	Length		Location.	Macadam.	Shoulders.		
	Miles.	Miles.	Feet.	Feet.	Feet.		
North-easterly, .	2.16	2.16	30-50	18-15	3	B-A.	1
Westerly, . .	.56	.56	60	15	3	B.	2
Westerly, . .	.51	.51	60	-	-	F.	3
North-easterly, .	3.90	3.90	50-65-66	18-15	5-4-3	B.	4
Southerly, . .	3.59	3.59	40-50-60	18-15	3	B.	5
North-easterly, .	.63	-	50+	15	-	B.	6
South-westerly, .	2.42	2.42	36-50	15	3	A.	7
Westerly, . .	1.29	1.29	50	15	4-3	B-D.	8
Westerly, . .	.31	.31	58-63	15	3	B-D.	9
South-westerly, .	1.29	1.29	50	15	3	A.	10
Northerly, . .	.57	.57	60-66	15	7.5	B.	11
Southerly, . .	.62	.62	66	15	-	B.	12
Southerly, . .	.39	.39	66	15	-	B-G.	13
North westerly, .	.58	.58	50	15	4-3	B.	14
Easterly, . .	1.50	1.50	50±-50-60	15	3	B.	15
Easterly, . .	1.47	1.47	50	15	3	B.	16
North-westerly, .	.75	-	50	15	-	B.	17
Easterly, . .	.19	.19	50	15	3	A.	18
Southerly, . .	.49	.49	50	15	-	B.	19
South-easterly, .	.51	.51	50	15	-	B.	20
North-easterly, .	1.03	1.03	60	-	-	F.	21
Westerly, . .	.39	.39	50-64	18-20	-	A.	22
Westerly, . .	.06	.06	50±	20	-	A.	23
Westerly, . .	2.74	2.74	40-66	15	3	B.	24
Westerly, . .	.20	.20	66	15	-	B.	25
North-westerly, .	.62	.62	50	15	-	G-A.	26
North-westerly, .	.38	.38	50	15	-	A-G.	27
South-easterly, .	.56	.56	50	15	3	A.	28
South-easterly, .	.55	.33	50	15	-	A.	29
South-westerly, .	1.98	1.98	50	15	3	B.	30
South-easterly, .	2.61	2.61	55-50-60	15	3	B-A.	31
Southerly, . .	.36	.36	60	-	-	F.	32
Northerly, . .	2.36	1.60	40	10-15[1]	-	K-M.	33
South-easterly, .	2.95	2.95	60	15	3	A-D.	34
North-westerly, .	1.28	1.28	50	15	3-5	B.	35

[1] Beach stone, 15 feet; broken stone and clay, 10 feet.

TABLE SHOWING THE HIGHWAYS LAID OUT, CONSTRUCTED OR

	TOWN.	Year.	ROAD LAID OUT.
			From —
1	Uxbridge,	1901,	End of 1898 lay-out,
2	Wales,	1901,	Brimfield line,
3	Walpole (south),	1894-95-97-1900,	Norfolk line,
4	Walpole (north),	1897-98,	Norwood line,
5	Walpole (north),	1900,	150 feet from the end of 1898 lay-out,
6	Ware,	1897-99-1900,	New Braintree line,
7	Wareham,	1896,	Near Weweantit bridge,
8	Wareham,	1898,	Cohasset Narrows bridge,
9	Wareham,	1901,	End of 1898 lay-out,
10	Wareham,	1901,	Marion line,
11	Warren,	1896-98,	West Warren,
12	Warren,	1899-1900,	Warren village,
13	Warren,	1901,	End of 1900 lay-out,
14	Watertown,	1895-96,	Waltham line,
15	Wayland,	1897-1900,	Weston line,[1]
16	Wellesley,	1901,	Natick line,
17	Wenham,	1897,	Beverly line,
18	Wenham,	1901,	End of 1897 lay-out,
19	Westborough,	1897,	Near insane hospital,
20	West Boylston,	1897-98,	Worcester line,
21	West Bridgewater,	1900,	Brockton line,
22	West Bridgewater,	1901,	End of 1900 lay-out,
23	West Brookfield (east),	1899-1900,	Brookfield line,
24	West Brookfield (west),	1899,	Ware line,
25	West Brookfield,	1901,	End of 1900 lay-out,
26	Westfield,	1894-96-98-99,	West Springfield line,
27	Westfield,	1898-99-1900,	End of town macadam,
28	Westfield,	1901,	End of 1900 lay-out,
29	Westminster,	1894-95-96-97-98-99,	Fitchburg line,
30	West Newbury,	1895-97,	Newburyport line,
31	Weston,	1898-99,	Near Waltham line,
32	Westport,	1894-95-97-98,	Dartmouth line,
33	West Springfield,	1895-96,	Top of Tapham hill,
34	West Tisbury,	1895-97,	Tisbury line,
35	Westwood,	1899-1900,	Norwood line to Dedham line,

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[1] Exclusive of 1,800 feet at Concord River and railroad crossing.

CONTRACTED FOR BY THE COMMISSION, ETC. — *Continued.*

Road Laid Out.		Length Constructed.	Widths.			Material of Road Surface.	
Direction.	Length.		Location.	Macadam.	Shoulders.		
	Miles.	Miles.	Feet.	Feet.	Feet.		
North-westerly, .	.50	.46	50	15	-	A.	1
South-westerly, .	1.04	Graded.	50+	-	-	N.	2
Northerly, . .	2.60	2.60	50	15	3	C-B.	3
Southerly, . .	1.70	1.70	50	15	3	B.	4
Southerly, . .	.24	.24	50	15	3	B.	5
Southerly, . .	1.80	1.80	50	15	3	A.	6
Easterly, . .	.57	.57	50	15	3	B.	7
Westerly, . .	1.05	1.05	40+	15	3	B.	8
South-westerly, .	.77	.60	40	15	-	B.	9
To 1896 lay-out, .	.14	Graded.	50-60	15	-	B.	10
Easterly, . .	1.89	1.89	49.5-50	15	3-4	A.	11
Easterly, . .	.94	.94	49.5	15	3	G-A.	12
To West Brookfield line.	.47	.47	49.5	15	-	A.	13
Easterly, . .	.85	.85	36	27	3-4	A-B.	14
North-westerly, .	2.27	2.27	50	15	3	B.	15
Easterly, . .	1.18	1.18	52-60-70	15	-	A-G.	16
Northerly, . .	.60	.60	50	15-18	4-12	A.	17
North-easterly, .	.51	.51	50	15	-	A.	18
North-westerly, .	.71	.71	50	15	3	B.	19
Northerly, . .	1.55	1.55	50	15	3	'97H, '98A-H.	20
Southerly, . .	1.00	1.00	60	15	3	B.	21
Southerly, . .	.97	.97	50-60+-115	15	-	B.	22
North-westerly, .	.81	.81	50	15	-	A.	23
South-westerly, .	.15	.15	50	15	3	A.	24
North-westerly, .	.69	.69	50	15	-	D.	25
Westerly, . .	2.22	2.22	50	18-15	3	A.	26
Westerly, . .	1.87	1.87	50+	18-15	3	A.	27
Westerly, . .	.82	.82	50	15	-	B.	28
South-westerly, .	3.00	3.00	50-60	15	3	D-C.	29
Westerly, . .	2.22	2.22	50-110	15	3-4.5	A-D.	30
Westerly, . .	3.15	3.15	50	18	-	C-B.	31
Easterly, . .	4.25	4.25	66-80	18	3	C-B.	32
Easterly, . .	1.53	1.53	50-136	18	3	A.	33
South-westerly, .	2.84	2.84	50	15-12-10	3	B.	34
Northerly, . .	1.05	1.05	45-55-60	15	3	B.	35

TABLE SHOWING THE HIGHWAYS LAID OUT, CONSTRUCTED OR

	TOWN.	Year.	ROAD LAID OUT.
			From —
1	Weymouth,	1894,	Holbrook line,
2	Weymouth,	1895–97,	Fore River to Back River,
3	Whately,	1899,	Deerfield line,[1]
4	Whately,	1901,	End of 1899 lay-out,
5	Whitman,	1894–96,	Brockton line,
6	Wilbraham,	1895–97,	Near Springfield line,
7	Wilbraham,	1901,	End of 1897 lay-out,
8	Wilbraham,	1901,	End of 1895 lay-out,
9	Williamsburg,	1896–98,	Goshen line,
10	Williamsburg,	1901,	End of 1898 lay-out,
11	Williamstown,	1895–96–98,	North Adams line,
12	Winchester,	1899–1900,	Arlington line to Woburn line,
13	Windsor,	1897,	Cummington line,
14	Woburn,	1900,	Winchester line,
15	Woburn,	1901,	End of 1900 lay-out,
16	Worcester,	1896–97,	Paxton line,
17	Worcester,	1897,	Holden line,
18	Worcester,	1900,	West Boylston line,
19	Wrentham,	1894–95–99–1900,	Plainville,
20	Wrentham,	1897–98,	Norfolk line,
21	Wrentham,	1901,	End of 1900 lay-out,
22	Yarmouth (north),	1894–96,	Barnstable line to Dennis line,
23	Yarmouth (south),	1895–97,	Bass River to Barnstable line,

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[1] Exclusive of 375 feet at railroad crossing.

CONTRACTED FOR BY THE COMMISSION, ETC. — *Concluded.*

Road Laid Out.		Length Constructed.	Widths.			Material of Road Surface.	
Direction.	Length.		Location.	Macadam.	Shoulders.		
	Miles.	Miles.	Feet.	Feet.	Feet.		
Easterly, . .	.25	.25	50	15	3	B.	1
Westerly, . .	1.75	1.75	125-50	15-18	3	A-B-C.	2
South-westerly, .	.78	.79	50	12	3	A.	3
South-westerly, .	.50	.42	50	15	-	A.	4
Easterly, . .	1.70	1.70	45	18	4	B.	5
Easterly, . .	1.91	1.91	50-79	15	3	A.	6
South-westerly, .	.22	.22	50	15	-	A.	7
Easterly, . .	.65	Partly graded.	50	15	-	A.	8
South-easterly, .	1.72	1.55	50	'98 graded. 15	3	B.	9
South-easterly, .	.39	Graded.	50	-	-	N.	10
Westerly, . .	1.92	1.92	50-60-70	15	3	D.	11
North-easterly, .	1.96	1.96	50	15-21-20	-	C.	12
Westerly, . .	.28	.28	50	-	-	F.	13
North-westerly, .	.93	.93	50	15	3	G-C.	14
North-westerly, .	.75	.50	40-50	15	-	G-C.	15
South-easterly, .	1.35	1.35	50	15	3	B.	16
Southerly, . .	.66	.66	50	15	3	B.	17
South-westerly, .	.54	.54	50	15	3	A.	18
Northerly, . .	3.27	3.27	26-34-50	15	3	B.	19
South-easterly, .	1.42	1.42	50	15	3	B.	20
Northerly, . .	.75	.75	50	15	-	B.	21
Easterly, . .	3.71	3.71	40-60	15	3	B.	22
Westerly, . .	5.10	5.10	40	15	3	B-C.	23

APPENDIX B.

TABLE SHOWING TOWNS AND CITIES IN WHICH WORK HAS BEEN DONE DURING THE YEAR 1901, THE RESIDENT ENGINEERS ON SUCH WORK, TOGETHER WITH DATES OF BEGINNING AND ENDING.

TOWN OR CITY.	County.	Lay-out.	Resident Engineer.	Date of Contract.	Date of Beginning.	Date of Ending.
					1901.	1901.
Abington,	Plymouth,	1900	Shaw, S.,	June 4, 1900,	April 26,	May 22.
Abington,	Plymouth,	1900	Everett, P. H.,	June 4, 1900,	April 11,	April 27.
Abington,	Plymouth,	1900	Everett, P. H.,	Sept. 27, 1900,	April 11,	April 27.
Abington,	Plymouth,	1900	Shaw, S.,	Sept. 27, 1900,	April 26,	May 22.
Abington,	Plymouth,	1901	Winslow, D. H.,	July 3, 1901,	July 16,	Aug. 7.
Abington,	Plymouth,	1901	Shaw, S.,	July 3, 1901,	Aug. 7,	Sept. 16.
Acton (west),	Middlesex,	1901	Everett, P. H.,	April 4, 1901,	May 27,	Aug. 29.
Acton (east),	Middlesex,	1901	Everett, P. H.,	June 13, 1901,	June 28,	Sept. 10.
Amesbury,	Essex,	1901	Adams, C. E.,	June 13, 1901,	June 28,	Nov. 1.
Amherst,	Hampshire,	1901	French, W. S.,	Oct. 24, 1901,	Nov. 6,	Dec. 11.
Attleborough,	Bristol,	1900	Shaw, S.,	Sept. 6, 1900,	April 17,	April 23.
Attleborough,	Bristol,	1901	Norton, C. H.,	Aug. 8, 1901,	Sept. 6,	Nov. 23.
Auburn,	Worcester,	1901	Lucy, A. E.,	Sept. 26, 1901,	Oct. 9,	Dec. 21.
Barnstable,	Barnstable,	1901	Holden, H. C.,	Aug. 22, 1901,	Oct. 5,	Dec. 26.
Barre,	Worcester,	1900	Packard, S. G.,	Oct. 25, 1900,	Jan. 1,	Jan. 19.
Barre,	Worcester,	1900	Farnham, A. B.,	Oct. 25, 1900,	April 17,	May 29.
Belchertown,	Hampshire,	1900	Farnham, A. B.,	Oct. 10, 1901,	June 5,	July 27.
Blackstone,	Worcester,	1900	Packard, S. G.,	Oct. 11, 1900,	April 3,	May 27.
Brewster (1),	Barnstable,	1901	Holden, H. C.,	Feb. 6, 1901,	Feb. 15,	July 31.

Brewster (2),	Barnstable,	1901	Holden, H. C.,	Feb. 14, 1901,	April 8,	Aug. 3.
Braintree,	Norfolk,	1900	Shaw, S.,	Nov. 8, 1900,	April 29,	July 26.
Brimfield,	Hampden,	1901	Bradford, J. L.,	Oct. 10, 1901,	Oct. 22,	Dec. 31.
Brockton,	Plymouth,	1900	Everett, P. H.,	June 4, 1900,	April 8,	April 27.
Brockton,	Plymouth,	1900	Shaw, S.,	June 4, 1900,	April 26,	May 27.
Charlton,	Worcester,	1901	Winslow, D. H.,	Oct. 3, 1901,	Nov. 20,	Dec. 31.
Chatham,	Barnstable,	1901	Holden, H. C.,	July 11, 1901,	Aug. 19,	Nov. 14.
Chelmsford,	Middlesex,	1901	Brown, C. L.,	Mar. 21, 1901,	April 26,	June 15.
Cheshire,	Berkshire,	1901	Farnham, A. B.,	Oct 10, 1901,	Oct. 25,	Nov. 13.
Chester,	Hampden,	1901	Farnham, A. B.,	Sept. 5, 1901,	Sept. 17,	Nov. 23.
Cohasset,	Norfolk,	1900	Norton, C. H.,	Sept. 6, 1900,	June 11,	July 11.
Colrain,	Franklin,	1901	Gerry, L. L.,	Oct. 3, 1901,	Oct. 22,	Dec. 16.
Concord,	Middlesex,	1900	Everett, P. H.,	Dec. 13, 1900,	June 10,	Aug. 3.
Dartmouth,	Bristol,	1901	Winslow, D. H.,	June 20, 1901,	Aug. 9,	Oct. 28.
Deerfield,	Franklin,	1900	Gerry, L. L.,	Dec. 6, 1900,	April 26,	July 10.
Deerfield,	Franklin,	1901	Gerry, L. L.,	Sept. 26, 1901,	Oct. 16,	Dec. 13.
Dennis,	Barnstable,	1901	Holden, H. C.,	June 27, 1901,	July 29,	Sept. 6.
Easthampton,	Hampshire,	1900	Gerry, L. L.,	Nov. 8, 1900,	May 9,	July 31.
Easthampton,	Hampshire,	1901	Gerry, L. L.,	Nov. 8, 1900,	May 9,	July 31.
Easton,	Bristol,	1900	Everett, P. H.,	Sept. 27, 1900,	April 11,	April 27.
Easton,	Bristol,	1900	Shaw, S.,	Sept. 27, 1900,	April 27,	May 4.
Edgartown,	Dukes,	1900	Litchfield, S.,	Oct 18, 1900,	April 26,	June 25.
Edgartown,	Dukes,	1901	Southworth, A. L.,	June 13, 1901,	Oct. 23,	Nov. 15.
Erving,	Franklin,	1900	Raymond, C. A.,	June 6, 1901,	July 19,	Aug. 23.
Erving,	Franklin,	1900	Gerry, L. L.,	June 6, 1901,	June 19,	Nov. 4.
Fitchburg,	Worcester,	1901	Phillips, H. D.,	Aug. 1, 1901,	Sept. 10,	Dec. 2.
Foxborough,	Norfolk,	1901	Brine, L. R.,	Oct. 10, 1901,	Oct. 20,	Dec. 4.
Gardner,	Worcester,	1900	Phillips, H. D.,	Sept. 6, 1900,	May 16,	July 30.
Gardner,	Worcester,	1901	Phillips, H. D.,	July 11, 1901,	July 18,	Aug. 24.
Gardner,	Worcester,	1901	Raymond, C. A.,	July 11, 1901,	July 19,	Oct. 17.
Greenfield,	Franklin,	1900	Gerry, L. L.,	Sept. 27, 1900,	May 3,	July 2.
Groton,	Middlesex,	1901	Phillips, H. D.,	Oct. 10, 1901,	Nov. 18,	Dec. 6.

TABLE SHOWING TOWNS AND CITIES IN WHICH WORK HAS BEEN DONE, ETC. — *Continued.*

TOWN OR CITY.	County.	Lay-out.	Resident Engineer.	Date of Contract.	Date of Beginning.	Date of Ending.
					1901.	1901.
Groveland,	Essex,	1900	Adams, C. E ,	Nov. 8, 1900,	May 2,	Aug. 10.
Groveland,	Essex,	1901	Adams, C. E.,	Nov. 8, 1900,	Dec. 2,	Dec. 17.
Hardwick,	Worcester,	1901	Farnham, A. B.,	April 11, 1901,	May 22,	July 27.
Harvard,	Worcester,	1900	Phillips, H. D.,	Nov. 22, 1900,	Jan. 1,	Feb. 20.
Harvard,	Worcester,	1900	Phillips, H. D.,	Nov. 22, 1900,	April 9,	July 23.
Harvard,	Worcester,	1900	Everett, P. H.,	Aug. 29, 1901,	Sept. 11,	Dec. 6.
Harwich,	Barnstable,	1901	Holden, H. C.,	Oct. 18, 1900,	April 5,	June 24.
Hatfield,	Hampshire,	1901	Packard, S. G.,	Oct. 3, 1901,	Nov. 8,	Dec. 6.
Haverhill,	Essex,	1899	Nichols, E. J.,	Dec. 16, 1900,	Jan. 1,	Sept. 6.
Lee,	Berkshire,	1900	Dadley, A. D.,	Aug. 16, 1900,	May 9,	Sept. 26.
Lenox,	Berkshire,	1900	Dadley, A. D.,	Aug. 3, 1900,	June 15,	Sept. 12.
Leominster,	Worcester,	1901	Phillips, H. D.,	Oct. 24, 1901,	Nov. 4,	Dec. 5.
Lexington,	Middlesex,	1900	Everett, P. H.,	Sept. 27, 1900,	May 22,	June 11.
Lunenburg,	Worcester,	1901	Phillips, H. D.,	Aug. 8, 1901,	Aug. 19,	Oct. 29.
Mansfield,	Bristol,	1901	Brine, L. R.,	Nov. 21, 1901,	Nov. 27,	Dec. 21.
Marion,	Plymouth,	1901	Howes, C. H.,	May 9, 1901,	Aug. 14,	Oct 10.
Marion (bridge),	Plymouth,	1901	Howes, C. H.,	April 25, 1901,	May 8,	Dec. 31.
Marlborough,	Middlesex,	1900	Welton, C. A.,	Sept. 6, 1900,	June 12,	June 25.
Marlborough,	Middlesex,	1901	Welton, C. A.,	June 13, 1901,	Aug. 5,	Dec. 4.
Marshfield,	Plymouth,	1901	Litchfield, S.,	Aug. 8, 1901,	Aug. 20,	Dec. 9.
Mattapoisett,	Plymouth,	1901	Howes, C. H.,	Sept. 5, 1901,	Sept. 30,	Dec. 19.
Merrimac,	Essex,	1901	Adams, C. E.,	July 18, 1901,	Aug. 9,	Nov. 11.
Methuen,	Essex,	1901	Brown, C. L.,	Aug. 22, 1901,	Sept. 18,	Nov. 14.
Millbury,	Worcester,	1900	Grimes, M. W.,	Nov. 8, 1900,	May 31,	June 29.
Millbury,	Worcester,	1900	Southworth, A. L.,	Nov. 8, 1900,	June 28,	Aug. 23.
Milton,	Norfolk,	1900	Shaw, S.,	Oct. 4, 1900,	June 12,	Sept. 16.
Monson,	Hampden,	1901	French, W. S.,	Sept. 5, 1901,	Sept. 20,	Nov. 18.

Montague,	Franklin,	1899	Gerry, L. L.,	May 16, 1901,	June 17,	Aug. 22.
Nantucket,	Nantucket,	1900	Farnham, A. B.,	Oct. 4, 1900,	Jan. 1,	Jan. 29.
Nantucket,	Nantucket,	1901	Gray, A. W.,	Sept. 12, 1901,	Nov. 4,	Dec. 31.
Natick,	Middlesex,	1901	Winslow, G. R.,	April 4, 1901,	May 7,	Sept. 17.
Newbury,	Essex,	1900	Adams, C. E.,	Oct. 4, 1900,	April 11,	June 24.
Newbury,	Essex,	1901	Adams, C. E.,	Sept. 26, 1901,	Oct. 31,	Dec. 27.
Newton,	Middlesex,	1901	- -	July 18, 1901,	Aug. 24,	Oct. 24.
North Adams,	Berkshire,	1900	Southworth, A. L.,	Sept. 27, 1900,	May 1,	May 19.
North Adams,	Berkshire,	1901	Bradford, J. L.,	July 3, 1901,	July 9,	Aug. 30.
Northborough,	Worcester,	1900	Welton, C. A.,	Oct. 25, 1900,	April 16,	June 22.
North Reading,	Middlesex,	1901	Gray, A. W.,	July 18, 1901,	July 29,	Oct. 21.
Orange,	Franklin,	1900	Raymond, C. A.,	June 6, 1901,	July 19,	Aug. 23.
Orange,	Franklin,	1901	Gerry, L. L.,	June 6, 1901,	June 19,	Nov. 4.
Palmer (1),	Hampden,	1901	Warren, H. E.,	April 24, 1901,	May 7,	June 28.
Palmer (2),	Hampden,	1901	French, W. S.,	Sept. 5, 1901,	Sept. 20,	Nov. 18.
Pittsfield,	Berkshire,	1901	Farnham, A. B.,	July 18, 1901,	Sept. 5,	Nov. 30.
Princeton,	Worcester,	1900	Grimes, M. W.,	Dec. 13, 1900,	May 15,	June 29.
Princeton,	Worcester,	1900	Southworth, A. L.,	Dec. 13, 1900,	June 28,	Aug. 1.
Provincetown,	Barnstable,	1901	Holden, H. C.,	May 23, 1901,	June 17,	July 15.
Reading,	Middlesex,	1900	Gray, A. W.,	Oct. 25, 1900,	April 23,	Aug. 13.
Richmond,	Berkshire,	1901	Brown, M. L.,	May 9, 1901,	Aug. 12,	Oct. 21.
Salem,	Essex,	1901	Wade, W. N.,	July 3, 1901,	Aug. 13,	Sept. 14.
Sandwich,	Barnstable,	1900	Dadley, A. D.,	Aug. 30, 1900,	Jan. 11,	Feb. 7.
Sandwich,	Barnstable,	1900	Dadley, A. D.,	Aug. 30, 1900,	Mar. 20,	May 8.
Sandwich,	Barnstable,	1900	Winslow, D. H.,	Aug. 30, 1900,	May 13,	May 20.
Seekonk,	Bristol,	1900	Grimes, M. W.,	Sept. 21, 1900,	April 5,	April 19.
Seekonk,	Bristol,	1900	Winslow, D. H.,	Sept. 21, 1900,	April 17,	May 27.
Seekonk,	Bristol,	1901	Winslow, D. H.,	Aug. 15, 1901,	Aug. 26,	Oct. 30.
Seekonk,	Bristol,	1901	Bagge, G. W.,	Aug. 15, 1901,	Nov. 21,	Dec. 2.
Shrewsbury,	Worcester,	1900	Welton, C. A.,	Sept. 27, 1900,	April 16,	June 27.
Somerset,	Bristol,	1901	Brown, G. R.,	Nov. 7, 1901,	Nov. 25,	Dec. 11.

TABLE SHOWING TOWNS AND CITIES IN WHICH WORK HAS BEEN DONE, ETC.— *Concluded.*

TOWN OR CITY.	County.	Lay-out.	Resident Engineer.	Date of Contract.	Date of Beginning.	Date of Ending.
					1901.	1901.
Spencer (1),	Worcester,	1900	Warren, H. E.,	June 14, 1900,	April 17,	July 6.
Spencer (2),	Worcester,	1900	Warren, H. E.,	Sept. 13, 1900,	April 17,	July 20.
Stoneham,	Middlesex,	1900	Gray, A. W.,	Oct. 25, 1900,	April 23,	Aug. 13.
Stoneham,	Middlesex,	1901	Gray, A. W.,	May 23, 1901,	June 8,	Aug. 13.
Sudbury,	Middlesex,	1901	Lucy, A. E.,	May 2, 1901,	May 31,	Sept. 30.
Sutton,	Worcester,	1901	Southworth, A. L.,	July 11, 1901,	July 24,	Oct. 10.
Swampscott,	Essex,	1900	Wade, W. N.,	Dec. 6, 1900,	May 23,	Aug. 22.
Swampscott,	Essex,	1901	Wade, W. N.,	Dec. 6, 1900,	May 30,	Aug. 22.
Taunton,	Bristol,	1901	Bagge, G. W.,	Sept. 12, 1901,	Sept. 21,	Nov. 30.
Templeton,	Worcester,	1901	Raymond, C. A.,	Sept. 5, 1901,	Sept. 26,	Nov. 27.
Tewksbury,	Middlesex,	1901	Dadley, A. D.,	Oct. 3, 1901,	Oct. 9,	Dec. 7.
Townsend,	Middlesex,	1900	Phillips, H. D.,	Nov. 1, 1900,	May 6,	June 14.
Townsend,	Middlesex,	1901	Phillips, H. D.,	June 27, 1901,	July 10,	July 21.
Townsend,	Middlesex,	1901	Phillips, H. D.,	Oct. 3, 1901,	Oct. 9,	Oct. 29.
Truro,	Barnstable,	1895	Holden, H. C.,	July 11, 1901,	Oct. 15,	Dec. 31.
Uxbridge,	Worcester,	1901	Brine, L. R.,	July 25, 1901,	Aug. 8,	Oct. 10.
Wales,	Hampden,	1901	Bradford, J. L.,	Oct. 10, 1901,	Oct. 22,	Dec. 31.
Wareham,	Plymouth,	1901	Howes, C. H.,	Aug. 15, 1901,	Oct. 9,	Dec. 19.
Wareham (bridge),	Plymouth,	1901	Howes, C. H.,	April 25, 1901,	May 8,	Dec. 31.
Warren,	Worcester,	1901	Warren, H. E.,	Aug. 1, 1901,	Aug. 26,	Nov. 26.
Wayland,	Middlesex,	1900	Winslow, G. R.,	June 7, 1900,	April 8,	May 18.
Wellesley,	Norfolk,	1901	Winslow, G. R.,	April 4, 1901,	May 7,	Sept. 17.
Wenham,	Essex,	1901	Brown, G. R.,	Aug. 8, 1901,	Sept. 9,	Nov. 14.
West Bridgewater,	Plymouth,	1900	Winslow, D. H.,	April 4, 1901,	April 17,	July 15.
West Bridgewater,	Plymouth,	1901	Wade, W. N.,	Aug. 8, 1901,	Sept. 17,	Dec. 4.
West Brookfield,	Worcester,	1901	Warren, H. E.,	June 27, 1901,	July 10,	Dec. 3.

Westfield,	Hampden,	1901	Farnham, A. B.,	July 18, 1901,	Aug. 5,	Oct. 5.
Whately,	Hampshire,	1901	Packard, S. G.,	Sept. 5, 1901,	Sept. 23,	Nov. 28.
Wilbraham (1),	Hampden,	1901	Warren, H. E.,	Mar. 21, 1901,	June 10,	July 11.
Wilbraham (2),	Hampden,	1901	Warren, H. E.,	Oct. 31, 1901,	Nov. 18,	Dec. 3.
Williamsburg,	Hampshire,	1901	Packard, S. G.,	April 24, 1901,	June 4,	Oct. 24.
Woburn,	Middlesex,	1900	Shaw, S.,	Oct. 11, 1900,	Sept. 20,	Nov. 2.
Woburn,	Middlesex,	1901	Shaw, S.,	Sept. 5, 1901,	Sept. 17,	Dec. 24.
Worcester,	Worcester,	1900	Grimes, M. W.,	Oct. 11, 1900,	April 26,	June 29.
Wrentham,	Norfolk,	1901	Norton, C. H.,	July 11, 1901,	July 31,	Sept. 21.

TABLE SHOWING TOWNS AND CITIES IN WHICH WORK HAS BEEN DONE, ETC. — *Concluded.*

TOWN OR CITY.	County.	Lay-out.	Resident Engineer.	Date of Contract.	Date of Beginning.	Date of Ending.
					1901.	1901.
Spencer (1),	Worcester,	1900	Warren, H. E.,	June 14, 1900,	April 17,	July 6.
Spencer (2),	Worcester,	1900	Warren, H. E.,	Sept. 13, 1900,	April 17,	July 20.
Stoneham,	Middlesex,	1900	Gray, A. W.,	Oct. 25, 1900,	April 23,	Aug. 13.
Stoneham,	Middlesex,	1901	Gray, A. W.,	May 23, 1901,	June 8,	Aug. 13.
Sudbury,	Middlesex,	1901	Lucy, A. E.,	May 2, 1901,	May 31,	Sept. 30.
Sutton,	Worcester,	1901	Southworth, A. L.,	July 11, 1901,	July 24,	Oct. 10.
Swampscott,	Essex,	1900	Wade, W. N.,	Dec. 6, 1900,	May 23,	Aug. 22.
Swampscott,	Essex,	1901	Wade, W. N.,	Dec. 6, 1900,	May 30,	Aug. 22.
Taunton,	Bristol,	1901	Bagge, G. W.,	Sept. 12, 1901,	Sept. 21,	Nov. 30.
Templeton,	Worcester,	1901	Raymond, C. A.,	Sept. 5, 1901,	Sept. 26,	Nov. 27.
Tewksbury,	Middlesex,	1901	Dadley, A. D.,	Oct. 3, 1901,	Oct. 9,	Dec. 7.
Townsend,	Middlesex,	1900	Phillips, H. D.,	Nov. 1, 1900,	May 6,	June 14.
Townsend,	Middlesex,	1901	Phillips, H. D.,	June 27, 1901,	July 10,	July 21.
Townsend,	Middlesex,	1901	Phillips, H. D.,	Oct. 3, 1901,	Oct. 9,	Oct. 29.
Truro,	Barnstable,	1895	Holden, H. C.,	July 11, 1901,	Oct. 15,	Dec. 31.
Uxbridge,	Worcester,	1901	Brine, L. R.,	July 25, 1901,	Aug. 8,	Oct. 10.
Wales,	Hampden,	1901	Bradford, J. L.,	Oct. 10, 1901,	Oct. 22,	Dec. 31.
Wareham,	Plymouth,	1901	Howes, C. H.,	Aug. 15, 1901,	Oct. 9,	Dec. 19.
Wareham (bridge),	Plymouth,	1901	Howes, C. H.,	April 25, 1901,	May 8,	Dec. 31.
Warren,	Worcester,	1901	Warren, H. E.,	Aug. 1, 1901,	Aug. 26,	Nov. 26.
Wayland,	Middlesex,	1900	Winslow, G. R.,	June 7, 1900,	April 8,	May 18.
Wellesley,	Norfolk,	1901	Winslow, G. R.,	April 4, 1901,	May 7,	Sept. 17.
Wenham,	Essex,	1901	Brown, G. R.,	Aug. 8, 1901,	Sept. 9,	Nov. 14.
West Bridgewater,	Plymouth,	1900	Winslow, D. H.,	April 4, 1901,	April 17,	July 15.
West Bridgewater,	Plymouth,	1901	Wade, W. N.,	Aug. 8, 1901,	Sept. 17,	Dec. 4.
West Brookfield,	Worcester,	1901	Warren, H. E.,	June 27, 1901,	July 10,	Dec. 3.

Westfield, ...	Hampden, . . .	1901	Farnham, A. B., . .	July 18, 1901,	Aug. 5,	Oct. 5.
Whately, ...	Hampshire, . . .	1901	Packard, S. G., . .	Sept. 5, 1901,	Sept. 23,	Nov. 28.
Wilbraham (1), . . .	Hampden, . . .	1901	Warren, H. E., . .	Mar. 21, 1901,	June 10,	July 11.
Wilbraham (2), . . .	Hampden, . . .	1901	Warren, H. E., . .	Oct. 31, 1901,	Nov. 18,	Dec. 3.
Williamsburg, ...	Hampshire, . . .	1901	Packard, S. G., . .	April 24, 1901,	June 4,	Oct. 24.
Woburn, ...	Middlesex, . . .	1900	Shaw, S., . . .	Oct. 11, 1900,	Sept. 20,	Nov. 2.
Woburn, ...	Middlesex, . . .	1901	Shaw, S., . . .	Sept. 5, 1901,	Sept. 17,	Dec. 24.
Worcester, ...	Worcester, . . .	1900	Grimes, M. W., . .	Oct. 11, 1900,	April 26,	June 29.
Wrentham, ...	Norfolk, . . .	1901	Norton, C. H., . .	July 11, 1901,	July 31,	Sept. 21.

APPENDIX C.

SHOWING CONTRACT PRICES ON

	CITY OR TOWN.	Contract Number.	Contractor.	Excavation.			Masonry (per Cubic Yard).		
				All Kinds (Cubic Yard).	Borrow (Cubic Yard).	Ledge (Cubic Yard).	Rubble Laid Dry.	Rubble Laid in Cement.	Cement.
1	Abington, . .	551	Ferranti, Milano & Co.,	$0 49	$0 67	$2 00	-	-	$12 00
2	Acton (west), .	526	John A. Gaffey, . .	50	40	1 50	$4 00	-	8 00
3	Acton (east), .	539	A. J. Wellington, . .	40	30	2 00	5 00	-	10 00
4	Acushnet,[3] . .	537	Town, ...	-	-	-	-	-	-
5	Amesbury, . .	540	James E. Watkins, .	35	50	1 50	2 75	-	4 80
6	Amherst, . .	607	W. N. Flynt Granite Co.,	50	60	3 00	-	-	-
7	Attleborough, .	568	A. J. Wellington, . .	50	40	3 00	6 00	-	12 00
8	Auburn, . . .	589	Town, ...	35	40	1 75	5 00	-	10 00
9	Barnstable, . . .	577	Town, ...	30	25	1 75	5 00	-	10 00
10	Belchertown, .	600	William Orlando, . .	55	-	2 00	6 00	-	11 00
11	Brewster, . .	521	Town, ...	-	-	-	-	-	-
12	Brewster, . .	522	Town, ...	-	-	-	-	-	-
13	Brimfield and Wales.	601	Nicholas White, . .	30	40	2 00	4 50	-	9 00
14	Charlton, . . .	595	Ferranti & Maguire, .	35	50	1 50	5 00	-	10 00
15	Chatham, . . .	559	Town, ...	25	-	1 75	6 00	-	10 00
16	Chelmsford, . .	523	Fred E. Ellis, ...	35	40	2 00	4 00	-	7 00
17	Chelsea,[12] . .	578	City, ...	-	-	-	-	-	-
18	Cheshire, . . .	602	John W. Polcaro, . .	38	48	1 25	-	$10 00	15 00
19	Chester, . . .	584	Myron R. Fisk, . .	50	50	3 00	6 00	-	10 00
20	Colrain, . . .	596	Town, ...	35	35	1 75	5 00	-	10 00
21	Dartmouth, . .	546	Town, ...	40	40	1 75	5 00	-	10 00
22	Deerfield, . . .	590	A. J. Wellington, . .	30	40	1 00	6 00	-	12 00
23	Dennis, ...	547	A. J. Wellington, . .	40	50	3 00	6 00	-	12 00
24	Edgartown, . .	541	Town, ...	25	25	1 75	5 00	-	10 00
25	Fitchburg, . .	566	David H. Damon, . . .	40	45	2 50	5 00	-	8 00

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[1] Twenty-inch clay.
[2] Twenty-inch iron.
[3] Lump sum, $2,500.
[4] Cobble-stone gutters.
[5] Screened.
[6] Fifteen-inch clay.
[7] Eight-inch clay.
[8] Leaching basins.

APPENDIX C.

STATE ROADS DURING 1901.

Gravel (Cubic Yard).	Shaping (Square Yard).	Broken Stone.		Pipe Culverts (per Lineal Foot).						Fencing (Lineal Foot).	Side Drains (Lineal Foot).	Bounds (Each).	Catch-basins (Each).	
				Clay.			Iron.							
		Local (Ton).	Trap (Ton).	Twelve-inch	Eighteen-inch.	Twenty-four-inch.	Twelve-inch.	Eighteen-inch	Twenty-four-inch.					
$0 85	$0 03.5	$1 69	-	-	-	-	-	-	-	$0 30	$0 33	$4 00	-	1
50	02	-	$1 90	$0 70	-	[1]$1 05	[2]$2 80	-	-	20	-	1 50	-	2
60	03	-	1 90	80	-	-	2 00	-	-	25	40	1 50	-	3
-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
50	02	1 46	-	-	$1 00	-	-	-	-	14	35	1 20	-	5
65	03	-	2 05	-	-	-	-	-	-	-	45 [4]45	2 00	$30 00	6
60 [5]1 10	-	-	-	70	1 20	[6]90	-	-	-	25	-	2 00	30 00	7
60	-	-	-	60	-	-	1 50	-	-	18	40	1 50	-	8
65	02	-	2 10	70	[7]40	-	-	-	-	20	50	1 50	Cost. [8]Cost.	9
-	03	-	2 00	-	-	-	-	$2 50	-	25	-	2 00	-	10
-	-	1 85	-	-	-	-	-	-	-	-	-	-	-	11
-	-	1 60	-	-	-	-	-	-	-	-	-	-	-	12
-	-	-	-	60	95	1 78	-	1 86	$1 90	22	-	2 25	-	13
-	02.5	1 45	[9]1 20	60	1 25	3 00	1 60	2 50	4 00	25	40	2 00	-	14
50	02	-	2 10	[7]40	-	-	-	-	-	17	50	1 50	-	15
-	03	-	1 85	60	[7]45	[10]50 [6]75	1 75	[11]1 40	-	25	40	1 50	25 00	16
-	-	-	-	-	-	-	-	-	-	-	-	-	-	17
53	-	-	-	-	-	-	-	-	-	-	-	2 20	-	18
80	03	-	1 95	1 25	2 50	-	1 75	3 00	-	24	-	2 00	-	19
50 [5]1 20	02	-	-	60	-	2 10	1 50	-	-	17	40	1 75	Cost.	20
65	02	1 50	-	-	-	-	-	-	-	17	40	1 50	-	21
50	03	-	1 70	80	-	-	1 80	-	-	25	-	2 00	30 00	22
[13]1 00	03	-	2 40	80	[7]40	-	-	-	-	-	-	1 50	30 00	23
1 00	02	2 10	-	70	-	[6]1 00	-	-	-	Cost.	50	1 50	-	24
50	02	1 62	-	55	-	-	-	-	-	22	25	1 50	30 00	25

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[9] Unscreened broken stone for foundation.

[10] Ten-inch clay.

[12] Lump sum, $12,400.

[11] Ten-inch iron.

[13] Loam for hardening sub-grade.

SHOWING CONTRACT PRICES ON

	CITY OR TOWN.	Contract Number.	Contractor.	EXCAVATION.			MASONRY (PER CUBIC YARD).		
				All Kinds (Cubic Yard).	Borrow (Cubic Yard).	Ledge (Cubic Yard).	Rubble Laid Dry	Rubble Laid in Cement.	Cement
1	Foxborough, .	603	Town, ...	$0 40	$0 45	$1 75	$5 00	-	$10 00
2	Gardner, . .	555	A. J. Wellington, . .	50	50	3 00	5 00	-	12 00
3	Groton, . .	604	A. J. Wellington, . .	40	50	2 00	6 00	-	15 00
4	Hardwick, . .	529	John S. Lane & Sons, .	50	50	-	5 00	-	10 00
5	Harvard, . .	579	Ferranti & Maguire, .	38	58	1 00	-	-	-
6	Hatfield, . .	597	A. J. Wellington, . .	40	40	1 00	6 00	-	12 00
7	Lakeville,[3] . .	593	Town, ...	-	-	-	-	-	-
8	Leominster, . .	608	Murphy & Gallagher, .	35	-	2 00	5 00	-	10 00
9	Lunenburg, . .	569	John J. Falvey, . .	50	60	2 00	6 00	-	20 00
10	Mansfield, . .	612	Wm. H. Doran, . .	35	50	1 00	5 50	-	12 00
11	Marion, . . .	544	Town, ...	35	50	1 75	5 00	-	9 00
12	Marion and Wareham.[4]	533	New Bedford & Onset Street Railway Co.	-	-	-	-	-	-
13	Marlborough, .	542	City, ...	35	50	1 75	5 00	-	10 00
14	Marshfield, . .	570	A. J. Wellington, . .	50	50	2 00	5 00	$7 00	12 00
15	Mattapoisett, .	580	Town, ...	40	40	1 75	5 00	-	10 00
16	Merrimac, . .	560	James E. Watkins, .	50	45	1 00	6 00	-	10 00
17	Methuen, . .	575	Fred E. Ellis, . . .	45	45	2 00	6 50	-	12 00
18	Montague, . .	534	A. J. Wellington, . .	-	-	-	-	-	-
19	Nantucket, . .	586	Rollin M. Allen, . .	30	[7]75	-	6 00	[8]6 50	10 00
20	Natick and Wellesley.	527	William H. Mague, .	35	50	2 00	5 00	-	12 00
21	Needham,[10] . .	576	Town, ...	-	-	-	-	-	-
22	Newbury, . .	591	Michael Cashman, . .	40	-	2 00	5 00	-	8 00
23	Newton,[11] . .	561	City, ...	-	-	-	-	-	-
24	North Adams, .	552	John S. Lane & Son, .	35	40	2 00	4 00	-	10 00
25	Northfield, . .	592	A. J. Wellington, . .	40	45	1 00	8 00	-	15 00
26	North Reading, .	562	Edward Adams, . .	35	40	2 00	5 00	-	10 00
27	Orange and Erving.	538	John O'Gara, . . .	30	-	2 00	4 00	-	8 00
28	Palmer, . .	530	W. N. Flynt Granite Co.,	45	45	-	5 00	-	10 00
29	Palmer and Monson.	585	W. N. Flynt Granite Co.,	45	45	3 00	5 00	-	10 00
30	Pittsfield, . .	563	Charles H. Hale, . .	40	50	2 00	6 00	-	10 00
31	Provincetown,[14] .	535	Town, ...	-	-	-	-	-	-

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[1] Eight-inch clay.
[2] Ten-inch clay.
[3] Lump sum, $5,500.
[4] Lump sum, $7,000.
[5] Relaying.
[6] Fifteen-inch clay.
[7] Clay hardening.
[8] Concrete masonry.

STATE ROADS DURING 1901 — *Continued.*

Gravel (Cubic Yard).	Shaping (Square Yard).	BROKEN STONE.		PIPE CULVERTS (PER LINEAL FOOT).						Fencing (Lineal Foot).	Side Drains (Lineal Foot).	Bounds (Each).	Catch-basins (Each).	
				CLAY			IRON.							
		Local (Ton).	Trap (Ton).	Twelve-inch.	Eighteen-inch.	Twenty-four-inch.	Twelve-inch.	Eighteen-inch.	Twenty-four-inch.					
$0 55	$0 02	$1 40	-	$0 65	[1]$0 45	[2]$0 55	-	-	-	$0 18	$0 40	$1 50	Cost.	1
-	03	-	$1 90	80	-	-	-	-	-	30	50	2 00	$25 00	2
1 00	03	-	1 75	80	-	-	$2 00	-	$4 00	30	50	2 00	30 00	3
-	03	-	1 70	70	1 20	-	2 00	-	-	-	45	1 50	25 00	4
-	02.5	1 61	-	-	-	-	-	-	-	-	-	-	-	5
-	03	-	1 75	-	[3]60	2 50	2 00	3 00	4 00	25	-	2 00	30 00	6
-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
65	-	-	-	65	1 00	2 50	1 75	3 50	4 75	25	-	2 00	-	8
-	02	1 90	2 10	-	-	-	-	-	-	25	50	2 00	-	9
55	03	1 45	-	80	-	-	-	-	-	25	-	1 50	25 00	10
60	02	1 35	-	[4]50	-	-	-	-	-	17	-	1 50	-	11
-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
85	02	1 55	-	65	-	-	Cost.	Cost.	-	17	40	1 50	Cost	13
-	03	1 70	-	80 [5]40	-	-	-	-	-	30	-	2 00	25 00	14
1 00	02	1 45	-	-	-	-	-	-	-	20	45	1 50	-	15
45	02.75	1 60	-	[6]80	1 10	2 00	-	3 45	-	25	85	1 50	-	16
60	03	1 95	-	-	-	2 75	1 75	-	-	20	45	2 00	-	17
-	-	-	1 74	-	-	-	-	-	-	-	-	-	-	18
-	03	2 75	-	-	-	[9]1 75	-	-	-	30	-	2 00	-	19
50	03	-	1 50	65	-	1 50	-	-	-	20	40	1 50	-	20
-	-	-	-	-	-	-	-	-	-	-	-	-	-	21
50	03	1 40	-	75	-	-	1 50	-	-	25	30	1 50	25 00	22
-	-	-	-	-	-	-	-	-	-	-	-	-	-	23
-	03	-	1 85	-	1 00	-	-	3 00	-	20	-	1 50	-	24
-	03	-	1 80	70	-	-	1 70	-	-	30	-	2 00	25 00	25
50	02	1 37	-	75	-	-	-	-	-	25	50	1 50	-	26
[12]1 20	02.5	1 55	-	-	1 25	-	-	-	-	18	37	1 50	25 00	27
60	03	-	1 95	-	-	-	-	-	-	25	45	2 00	-	28
65	03	-	2 05	-	-	-	-	-	-	25	-	2 00	-	29
-	03	-	1 85	-	-	-	-	3 00	[13]5 00	25	40	1 50	-	30
-	-	-	-	-	-	-	-	-	-	-	-	-	-	31

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[9] Twenty-inch clay.

[10] Lump sum, $5,340.

[11] Lump sum, $6,000.

[12] Screened.

[13] Thirty-inch iron.

[14] Lump sum, $700.

SHOWING CONTRACT PRICES ON

	CITY OR TOWN	Contract Number.	Contractor.	Excavation.			Masonry (per Cubic Yard).		
				All Kinds (Cubic Yard).	Borrow (Cubic Yard).	Ledge (Cubic Yard).	Rubble Laid Dry.	Rubble Laid in Cement.	Cement.
1	Richmond, . .	545	Town, ...	$0 40	$0 40	$1 75	$5 00	-	$10 00
2	Salem, . . .	553	A. J. Wellington, . .	40	-	-	-	-	15 00
3	Seekonk, . .	573	Town, ...	40	35	1 75	5 00	-	10 00
4	Somerset, . .	611	Town, ...	40	40	1 75	5 00	$8 00	10 00
5	Stoneham, . .	536	Edward Adams, . .	50	60	2 00	5 00	-	10 00
6	Sudbury, . .	582	Nicholas White, . .	30	40	1 00	4 00	-	8 00
7	Sutton, . . .	556	Town, ...	40	45	1 75	5 00	-	10 00
8	Taunton, . .	587	Ferranti & Maguire, .	41	51	-	6 25	9 10	13 20
9	Templeton, . .	581	A. J. Wellington, . .	40	50	3 00	8 00	10 00	12 00
10	Tewksbury, . .	598	A. J. Wellington, . .	40	40	2 00	5 00	-	12 00
11	Townsend, . .	548	Richard A. Clink, . .	30	-	1 00	4 00	-	10 00
12	Townsend, . .	599	William H. Doran, .	40	-	1 00	6 00	-	14 00
13	Truro, . . .	557	A. J. Wellington, . .	-	[4]1 30	-	-	-	-
14	Uxbridge, . .	565	John S. Lane & Sons, .	35	40	2 00	5 00	-	10 00
15	Wareham, . .	574	Town, ...	25	-	1 75	6 00	-	12 00
16	Warren, . .	567	John S. Lane & Sons, .	40	45	2 00	4 00	10 00	12 00
17	Wenham, . .	571	Town, ...	40	40	1 75	5 00	-	10 00
18	West Bridgewater,	528	Ferranti, Milano & Co., .	41	-	1 00	4 00	-	10 00
19	West Bridgewater,	572	A. J. Wellington, . .	40	50	3 00	6 00	-	12 00
20	West Brookfield, .	549	John O'Gara, . . .	35	50	1 75	4 00	6 50	11 00
21	Westfield, . .	564	Town, ...	35	40	1 75	5 00	[9]6 00	-
22	Whately, . .	582	A. J. Wellington, . .	30	40	1 00	6 00	-	12 00
23	Wilbraham, . .	524	Amos D. Bridge, . .	35	40	-	6 00	-	12 00
24	Wilbraham, . .	610	Amos D. Bridge, . .	35	45	1 00	6 00	-	12 00
25	Williamsburg, .	531	Amos D. Bridge, . .	40	-	-	5 00	8 00	12 00
26	Williamsburg,[12] .	550	American Bridge Co., .	-	-	-	-	-	-
27	Woburn, . .	583	John A. Gaffey, . .	38	-	1 50	4 00	-	8 00
28	Wrentham, . .	558	Town, ...	40	40	1 75	5 00	-	9 00

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[1] Screened.
[2] Eight-inch clay.
[3] Fifteen-inch clay.
[4] Clay hardening.
[5] Relaying fifteen-inch clay pipe.
[6] Ten-inch clay.

STATE ROADS DURING 1901 — *Concluded.*

Gravel (Cubic Yard).	Shaping (Square Yard).	Broken Stone.		Pipe Culverts (per Lineal Foot).						Fencing (Lineal Foot).	Side Drains (Lineal Foot).	Bounds (Each).	Catch-basins (Each).	
				Clay.			Iron.							
		Local (Ton).	Trap (Ton).	Twelve-inch	Eighteen-inch.	Twenty-four-inch.	Twelve-inch	Eighteen-inch.	Twenty-four-inch.					
$0 65 [1]80	-	-	-	-	$1 25	-	-	-	-	$0 17	$0 40	$1 50	-	1
50	-	-	-	$0 80	-	-	-	-	-	30	-	2 00	-	2
65	-	-	-	65	-	-	-	-	-	17	35	1 50	-	3
65	$0 02	$1 50	-	65	[2]40	-	-	-	-	17	40	1 50	Cost.	4
75	03	1 40	-	-	-	-	-	-	-	25	35	2 00	-	5
46	02.5	1 50	-	60	1 18	-	$1 45	$2 65	-	21	-	2 00	-	6
1 00	02	1 20	-	65	-	-	Cost.	-	-	17	45	1 75	-	7
59	02.5	1 97	-	-	-	-	-	-	-	26	-	2 50	-	8
1 00	03	-	$1 80	70	-	$2 50	1 80	-	$4 00	30	40	2 00	$20 00	9
60	03	-	1 65	70	[2]60	[3]80	-	-	-	30	40	2 00	30 00	10
74	-	-	-	75	-	-	-	-	-	25	-	1 50	-	11
90	-	-	-	90	-	-	-	-	-	30	-	1 50	-	12
-	-	2 80	-	-	-	-	-	-	-	-	-	-	-	13
-	03	-	2 00	-	-	-	-	-	-	25	-	1 50	-	14
75	02	1 55	-	70	-	-	-	-	-	17	45	1 50	Cost.	15
-	03	-	1 95	[5]20	1 25	-	1 75	-	4 00	20	-	1 50	25 00	16
65	02	-	1 85	[6]50	-	[9]90	[7]1 10	[8]2 25	-	17	40	1 50	25 00	17
-	03.5	1 45	-	70	-	1 90	-	-	-	24	-	3 00	25 00	18
50	03	1 50	-	[2]40	1 20	[3]1 00	-	-	-	30	50	2 00	-	19
60	03	1 55	1 80	-	1 50	-	1 50	3 00	4 00	18	37	2 00	-	20
50	02	1 35	-	-	-	-	-	-	[10]1 75	17	40	1 50	-	21
-	03	-	1 80	-	-	2 50	-	-	4 00	30	-	2 00	-	22
-	03	-	2 25	1 00	-	-	2 00	-	-	-	-	1 50	-	23
-	03	-	1 85	75	-	-	2 00	-	-	25	-	1 50	-	24
-	-	-	-	-	-	2 50	-	-	-	25	50	1 75	[11]1 00	25
-	-	-	-	-	-	-	-	-	-	-	-	-	-	26
45	02	1 48	-	65	-	[9]90	[8]2 50	-	-	20	35	1 40	20 00	27
60	02	1 60	-	60	-	-	-	-	-	17	35	1 40	Cost.	28

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[7] Ten-inch iron.

[8] Sixteen-inch iron.

[9] Concrete masonry.

[10] Fourteen-inch iron.

[11] Rip-rap.

[12] Lump sum, $1,150.

APPENDIX D.

STATEMENT OF CLAIMS AGAINST THE COMMISSION.

[AS REQUIRED BY CHAPTER 18, SECTION 5, OF THE REVISED LAWS.]

NAME.	Residence.	Nature of Claim.	Amount.	Remarks.
Bennett, J. C.,	Lynn,	Damages caused by taking of land in Lynn,	-	Settled in part.
Bigelow, O. J.,	Athol,	Damages caused by taking of land in Athol,	-	Award pending.
Crowell, T. H.,	Somerville,	Damages caused by construction of State road in Chatham,	-	Suit entered.
Dane, G. E. F., estate of,	Hamilton,	Damages caused by taking of land in Hamilton,	-	Suit entered.
Gookin, J. S.,	Revere,	Damages caused by construction of State road in Revere,	$10 77[1]	Award not yet accepted.
Gould, C. E.,	Leicester,	Damages caused by construction of State road in Leicester,	800 00	Suit entered.
Haviland, J. B.,	Ludlow,	Bill for services in making surveys,	948 74	Suit entered.
Hayes, M.,	Salem,	Damages caused by taking of land in Salem,	-	Award pending.
Massasemet Yarn Mills,	Colrain,	Damages caused by construction of State road in Colrain,	-	Suit entered.
Moseley, S. E.,	Revere,	Damages caused by construction of State road in Revere,	33 65[1]	Award not yet accepted.
Parker, C. H.,	Revere,	Damages caused by construction of State road in Revere,	4 16[1]	Award not yet accepted.
Wilkins, M. A.,	Swampscott,	Damages caused by construction of State road in Swampscott,	5 00[1]	Award not yet accepted.

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[1] Amount awarded by commission.

APPENDIX E.

THE DISTRIBUTION OF STATE ROADS IN THE COMMONWEALTH.

For the information of the many interested in this question, the following is reprinted from the report of 1897 : —

The selection of roadways which shall be rebuilt as State roads at the expense of the Commonwealth is naturally the most difficult problem with which the commission has to deal. The nature of that problem will be more readily understood after an examination of the map of the State, which forms a part of this report, on which is laid down, in addition to county and town boundaries, the roadways which the commission has been petitioned to take, and those which it has up to this date actually accepted as State roads, nearly all of the latter having been actually constructed.

Under the provisions of the law the commissioners are not permitted to control the expenditure of the appropriation entirely by their own judgment. They are restricted to two provisions, the wisdom of which they do not at all criticise, but which should always be kept in mind in considering the results of their labors. The first of these is that "all constructions of State roads shall be fairly apportioned among the different counties," and in this they have been guided in the main by the relative miles of roadway existing in the several counties. The second is the restriction growing out of the use of the petition. It was obviously the intention of the Legislature to limit the initiative of the Highway Commission in planning for the location of State ways. As is well known, the commission cannot of its own motion accept or reject any route; it has to await the petitions of the municipalities or the county commissioners. The only manner in which it can effect any satisfactory grouping of these petitions, so that continuous routes may come from the constructive work, is by rejecting the petitions which may come to it, or by counselling with the authorities having the right to petition in advance of their formal requests.

In order to keep the State roads from having a total lack of ultimate purpose in their relations to each other in the distribution of the

Commonwealth, the commission has been compelled gradually, though not formally, to come to a state of mind as regards the selection of roads which are to be taken. In part, this rather undetermined project is indicated by the distribution of the routes which have been accepted, as is shown on the accompanying map.* In part, though less distinctly, it is indicated by the direction of the petitions, the greater part of which have been submitted after more or less conference with the commission.

It appears to your commission that the time has now come when some statement, still necessarily tentative, shall be made which will set forth in a general way the views of the commission as to the policy to be followed by the Commonwealth in the construction of State roads. This statement is submitted in no sense as a hard-and-fast plan, but in order to set forth the direction in which the work of the commission is inevitably drifting; and we should hope that this statement may provoke criticism, and, if need be, modification of the action.

It seems, in the first place, clear that the most important of the many needs which are to be met by the construction of State roads is that which relates to the connection of centres of business in the Commonwealth with each other, in so far as the business relations demand this connection. Thus, where two towns have a large exchange of relations, the way lying through other towns which profit little by the traffic, there is good reason why the State should take charge of the main connecting way.

Closely related to this is the case of a considerable number of smaller, less populous towns, surrounding a large city or centre of dense population, with which they have intimate business relations. It furnishes the market for their products, and the profit to the producer as well as the cost to the consumers is largely determined by the cost of local transportation. Even where facilities for transportation by rail exist, there is still much use of the public highway whenever it is in reasonably good condition. It is in evidence before the commission that many articles of produce, especially perishable and delicate fruits, are preferably sent many miles to the city markets in farm wagons, where shipping by rail would be both quicker and cheaper, on account of the better condition in which they may be delivered.

In making its selection among numerous petitions, the commission has endeavored to keep in mind the great advantages arising from easy connections between large centres of population and the surrounding agricultural areas; for in so doing the demands of both urban and suburban populations are recognized, and their mutual interests promoted.

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* See end of report.

Another class of cases arises, in which one or more towns lie remote from the rail or water ways, losing opportunities of advancement on account of this hindrance. These conditions are in some cases so grave that the average cost during the year of transporting a ton of freight from a village otherwise well placed for manufacturing to the business centres of the Commonwealth is greater than would be incurred in transporting the same burden from the central portion of the Mississippi valley to the city of Boston. In these cases, also, the commission feel impelled to better the traffic conditions by improving the way.

In yet other but not numerous cases, portions of the State adjacent to this Commonwealth have their natural business centres in some of our cities or towns, but the people thus residing beyond the bounds of the Commonwealth are deterred from seeking access to its markets by the difficulties of the way. In such instances it seems desirable that good roads should be provided to the bounds of the Commonwealth.

The conditions above mentioned may be regarded as of a local character. There remains yet another of such interests of a general nature to be provided for. These will be met by so grouping the State roads that they will in the end afford continuous routes through the Commonwealth, which may serve the interests of pleasure travel or the occasional distant carriage which would be done by ordinary wagons where the roads were good. These extended ways, including in general those which relate to driving for a distance of more than fifteen miles, are of greater importance to the interests of the Commonwealth than might at first sight appear. A considerable part of the present and much of the prospective value of real estate in the Commonwealth, as well as the traffic which takes place therein, is due to the incoming of people from the central and western parts of the country, who seek summer residences and family homes in the very attractive rural districts of the State. People who thus resort to the Commonwealth for recreation desire opportunities for driving such as would be afforded by a well regulated system of State ways, which would be laid out and beautified with some reference to the natural and historic interests of the country. It is hardly necessary to say that the use of the bicycle for pleasure travel would also be thus accommodated.

Although the commissioners do not propose to build roads which relate only or even mainly to pleasure travel, they feel that the service which can be done by a system which relates to such travel is so great and of such economic importance to the Commonwealth that it should always be kept in mind.

An examination of the map referred to above will reveal in some degree the groupings of highways up to this time, as indicated by petitions and by acceptance. A few rather long, continuous lines of State highway are apparently demanded at the present time, and their construction ought to be kept in view in the acceptance of petitions; but the commission must not allow itself to be too much influenced by an adjustment of petitions, which often stand only for local interest and activity. While there is often good reason for accepting one highway on account of local conditions, although it may not form a part of any general scheme, and another because it does fit into such a scheme, although of less local value than another which may be near by, there is often equally good reason for postponing action on a third because it is relatively of less *immediate* importance than either of the others.

The commissioners are of the opinion that nearly every mile of road thus far petitioned for should some time be built as a State highway; but it is clear that, as only a comparatively small number of miles can be completed annually, some selection must be made.

In choosing which shall be undertaken first, the commissioners must be governed by considerations of the broadest character, many of which will not be evident to those who necessarily think most of local interests. The order of presentation of petitions can have no influence, nor should it be inferred that, because a petition is not granted this year, it may not be next, or the year after. Outside of the limitations put upon them by the statute, the commissioners are bound to exercise their best judgment in all cases; and, while they are likely to be far from infallible, and welcome fair criticism, all who are unselfishly interested in the extension of this important system of State highway construction are likely to accept the judgment as the result of a comprehensive knowledge of the whole situation, growing out of the necessary consideration of the scheme as a whole.

APPENDIX F.

LAWS RELATING TO THE WORK OF THE COMMISSION.

[REVISED LAWS, CHAPTER 47.]

OF STATE HIGHWAYS.

Massachusetts highway commission.
1893, 476, §§ 1, 3.
1898, 528.
1900, 474, § 1.

SECTION 1. There shall be a Massachusetts highway commission consisting of three persons, one of whom shall be annually appointed by the governor, with the advice and consent of the council, for a term of three years. The chairman shall be designated by the governor and shall receive an annual salary of thirty-five hundred dollars. Each of the other members shall receive an annual salary of twenty-five hundred dollars. Each member of the commission shall be allowed his travelling expenses, and shall devote his time to the business of the commission. The commission may expend annually for a secretary, clerk hire, engineers and for incidental expenses such amount as the general court may appropriate. It shall be provided with an office in the state house or some other suitable place in the city of Boston, in which the records of its office, maps, plans and statistics collected and compiled under its direction shall be kept.

Duties, etc.
1893, 476, § 2.

SECTION 2. It shall compile statistics relative to the public ways of counties, cities and towns, and make such investigations relative thereto as it shall consider expedient. It may be consulted by, and shall, without charge, advise officers of counties, cities or towns having the care of and authority over public ways, as to their construction, maintenance, alteration or repair; but such advice shall not impair the legal duties and obligations of any county, city or town. It shall prepare maps of the commonwealth on which shall be shown county, city and town boundaries, the public ways and the state highways, with their names if practicable. It shall collect and collate information relative to the geological formation of the commonwealth so far as it relates to the materials suitable for road building, the location of which it shall, so far as practicable, designate on said maps, which shall be open to the inspection of officers of counties, cities and towns having the care of and authority over public ways. It shall give public notice of and hold at least one public meeting annually in each county for the open discussion of questions relative to public ways.

Annual report, etc.
1893, 476, §§ 3, 5.

SECTION 3. It shall make an annual report to the general court of its doings and the expenditures of its office, with such statements relative to the construction and maintenance of public ways, such recommendations as to the general policy of the commonwealth relative thereto as it considers appropriate, and an estimate of the amount necessary to carry out the provisions of this chapter for the year beginning with the first day of March following. The report shall be transmitted to the secretary of the commonwealth on or before the first Wednesday in January.

Officers to furnish commissioners with information.
1893, 476, § 4.

SECTION 4. County commissioners and city and town officers who have the care of and authority over public ways and bridges shall, on request, furnish the commission with any information required by it concerning such ways and bridges.

Petition for state highway.
1893, 476, § 6.
1894, 497, § 1.
1898, 476.
178 Mass. 403.
[1 Op. A. G. 587.]

SECTION 5. If the county commissioners of a county, the mayor and aldermen of a city or the selectmen of a town adjudge that the public necessity and convenience require that the commonwealth take charge of a new or an existing way as a highway, in whole or in part, in their county, city or town, they may apply by a petition in writing to the commission, requesting that said way be taken charge of by the commonwealth.

Location of state highway.
1893, 476, § 6.
1894, 497, § 2.
1896, 345, § 3.
1897, 355, § 1.
[1 Op. A. G. 284.]

SECTION 6. If said commission determines that public necessity and convenience require that such way should be laid out or be taken charge of by the commonwealth, it shall file a certified copy of a plan thereof, a copy of the petition therefor and a certificate that they have laid out and taken charge of said highway in accordance with said plan, in the office of the county commissioners for the county in which the way is situated, and shall file a copy of the plan and location of the portion lying in each city or town in the office of the clerk of said city or town, and thereafter it shall be a state highway, and shall be constructed and kept in good repair and condition by the commission, at the expense of the commonwealth.

Alteration of location.
1900, 475, § 1.

SECTION 7. Said commission may, with the concurrence of the mayor and aldermen of a city or the selectmen of a town, alter the location of a state highway in such city or town by filing a plan thereof and a certificate that said commission has laid out and taken charge of said state highway, as altered in accordance with said plan, in the office of the county commissioners for the county in which said highway is situated, and by filing a copy of the plan or location as altered in the office of the clerk of such city or town.

Abandonment of location.
1900, 475, § 2.

SECTION 8. Said commission may, with the concurrence of the mayor and aldermen of a city or the selectmen of a town, abandon any land or part thereof, or rights in land which have been taken or acquired by it in such city or town by executing, acknowledging and recording a deed thereof accompanied by a plan of survey which shall be recorded therewith. Said abandonment shall revest the title to the land or rights abandoned in the persons, their heirs and assigns, in whom it was vested at the time of the taking, and may be pleaded in reduction of damages in any suit therefor on account of such taking.

Damages.
1894, 497, § 3.
1900, 475, § 1.
1901, 345.
172 Mass. 223.

SECTION 9. The damages sustained by any person whose property has been taken for or has been injured by the construction or alteration of such highway shall be determined by said commission and shall be paid by the commonwealth. A person who is aggrieved by such determination may, upon a petition filed in the superior court for the county in which the land lies within one year after the completion of said highway or alteration thereof, have said damages determined by a jury in the same manner as damages which have been sustained by the taking of land for other highways. The mayor of a city, if so authorized by a vote of the board of aldermen, or the selectmen of a town, if so authorized by a vote of the town, may stipulate in writing in behalf of the city or town to indemnify and save harmless the commonwealth against all claims and demands for damages which may be sustained by any person whose property has been taken for, or has been injured by the construction of, any highway which the Massachusetts highway commission proposes to lay out and construct as a state highway, and thereupon such town or city shall be liable ultimately for the amount of any verdict against the commonwealth for such damages, and for costs, the amount thereof to be recoverable by the commonwealth in an action of contract.

Construction of state highways by cities and towns.
1893, 476, §§ 9, 10.
1894, 497, § 4.
1897, 355, § 2.
1900, 404.
[1 Op. A. G. 370, 397.]

SECTION 10. Said commission shall, when about to construct a highway, give to each city and town in which it lies a certified copy of the plans and specifications therefor and a notice that said commission is ready for its construction; and said city or town may, without advertisement, contract with said commission for the construction of so much of such highway as lies within its limits, in accordance with the plans and specifications and under its supervision and subject to its approval, at a price agreed upon between said commission and said city or town. If, within ten days, said city or town does not elect so to contract, said commission shall advertise in two or more newspapers published in each county in which the highway lies, and in three or more daily newspapers published in Boston, for sealed proposals for the construction of such highway, stating the time and place for opening said proposals, and reserving the right to reject any and all proposals. Said commission may reject any and all proposals or, if a proposal is satisfactory, it shall, with the approval of the governor and council, make a contract in writing on behalf of the commonwealth for such construction. After they have been accepted or rejected they shall be kept by the commission, and shall be open to public inspection. The commission may, in the same manner and under the same conditions, contract with a city or town or, if a city or town shall not elect so to contract, with a person for the grading of a state highway or for furnishing materials or any other element in its construction. The construction of all state highways shall be under the supervision and subject to the approval of the commission and in accordance with plans and specifications furnished by it, shall be fairly apportioned by the commission among the different counties, and not more than ten miles of state highway shall be constructed, on petition as aforesaid, in any one county in any one year, without the previous written approval of the governor and council.

Maintenance of state highways.
1894, 497, §§ 2, 7.
1897, 355, § 1.

SECTION 11. Said commission shall keep all state highways reasonably clear of brush, shall cause suitable shade trees to be planted thereon if practicable, and may establish and maintain watering troughs upon said highways. No opening shall be made in any such highway nor shall any structure be placed thereon, nor shall any structure which has been placed thereon be changed or renewed, except in accordance with a permit from the commission, which shall exercise complete and permanent control over such highways.

Reimbursement of commonwealth.
1894, 497, § 5.

SECTION 12. One-fourth of any money which may be expended under the provisions of the seven preceding sections for a highway in any county, with interest thereon at the rate of three per cent per annum, shall be repaid by said county to the commonwealth in such instalments and at such times within six years thereafter as said commission, with the approval of the auditor of accounts, having regard to the financial condition of the county, shall determine. The treasurer and receiver general shall apply the money so repaid to the appropriation to be expended by said commission.

Commonwealth primarily liable for defective highways.
1893, 476, § 13.
1894, 497, § 6.
1896, 345, § 1.
1900, 253, §§ 1, 2.
[1 Op. A. G. 284.]

SECTION 13. The commonwealth shall be liable for injuries sustained by persons while travelling on state highways, in the manner and subject to the limitations, conditions and restrictions provided in sections eighteen, twenty and twenty-one of chapter fifty-one, except that notice of the injury shall be given to a member of the commission or to its secretary. The commonwealth shall not be liable for an injury which may be sustained upon the sidewalk of a state highway or during the construction of such highway. The amount which may be recovered for any such injury shall not exceed one-fifth of one per cent of the state valuation last preceding the commencement of the action of the city or town in which the injury was received, nor shall it exceed four thousand dollars.

State highway to be kept clear of snow and ice.
1893, 476, § 14.
1894, 497, § 6.
1896, 345, § 2.
1900, 258, § 2.

SECTION 14. A city or town in which a state highway lies shall at its own expense keep such highway sufficiently clear of snow and ice to be reasonably safe for travel. It shall have police jurisdiction over all state highways within its limits, and shall forthwith give notice in writing to the commission or its employees of any defect or want of repair in such highways; but it may make temporary necessary repairs of a state highway without the approval of the commission.

Maintenance and repair of state highways.
1898, 476, § 10.

SECTION 15. Said commission shall contract with the city or town in which such state highway lies or with a private person for the maintenance or repair thereof in accordance with the regulations of said commission, and subject to their supervision and approval. Such contracts may be made without previous advertisement.

Expense of repairs, payment, and reimbursement of.
1900, 432, § 1.

SECTION 16. Said commission shall annually, in January, certify to the treasurer and receiver general the amount of the expenditures for repair of state highways in each city and town during the preceding year. The amount of such expenditures, not exceeding fifty dollars a mile, shall be made a part of the state tax for such cities and towns respectively, and be credited to the appropriation for state highways to be used again by the commission. If a city or town elects to make such repairs upon terms and prices agreed upon by it and said commission and under the direction of said commission, the commission shall repay to it, from the annual appropriation for state highways, the amount expended therefor in excess of fifty dollars a mile.

Repair of ways in towns having no state highway.
1900, 432, § 2.
1901, 433.

SECTION 17. The commission shall expend in such towns, the valuation of which does not exceed one million dollars and in which no state highway has been built, and in such amounts, as it determines, five per cent of the amount appropriated each year for the construction and repair of state highways, in constructing and repairing ways in such towns. It may also expend a further amount of not more than five per cent of said appropriation in towns the valuation of which exceeds one million dollars in such amounts as it determines, if such towns appropriate, to be expended under the provisions of this and the preceding section, an amount, in addition to the average annual appropriations for repairs of highways in such town for the preceding five years, equal to the amount allotted by said commission. Such allotments and expenditures shall be made only upon the petition of the selectmen of the towns, and a way constructed or repaired under the provisions of this section shall not thereby become a state highway. No town shall so receive in any one year more than forty per cent of its average annual appropriations for highway purposes for the preceding five years.

Construction of state highways.
1896, 345, § 1.

SECTION 18. Said commission shall construct and maintain such portion of a state highway as lies between the lines of the sidewalks nearest to the centre of the way. The sidewalks of said way may be constructed and maintained in accordance with the provisions of sections forty-two and forty-three of chapter forty-nine.

Road machines to be provided.
1895, 486
1896, 513, § 1.
1897, 355, § 3.
1901, 416.
[1 Op. A. G. 358.]

SECTION 19. Steam road rollers and other road machinery owned by the commonwealth shall be managed and maintained under the direction of said commission, which may engage competent engineers and mechanics to operate and keep said machines in repair, may purchase all needed materials and supplies, and may incur such other expenses as may be necessary to operate, maintain and transport said machines. Upon the application of the selectmen or road commissioners of a town of not more than twelve thousand inhabitants, said commission may furnish such road machinery for use in building or repairing ways in that town. The expenses incurred under the provisions of this section shall be paid by the towns using said machines, as apportioned and directed by said commission.

Rights of adjoining owner or occupant, etc.
1893, 476, § 12.

SECTION 20. No length of possession, or occupancy of land within the limits of a state highway, by an owner or occupant of adjoining land shall give him any title thereto, and any fences, buildings or other obstructions encroaching upon a state highway shall, upon written notice by said commission, be forthwith removed by the owner or occupant of adjoining land, and if not so removed, said commission may cause the same to be removed upon said adjoining land.

Laying pipes, planting trees, etc., regulated. 1893, 476, § 14. [1 Op. A. G. 317.]

SECTION 21. No state highway shall be dug up for laying or placing pipes, sewers, poles, wires or railways or for other purposes, and no tree shall be planted or removed or obstruction placed thereon, without the written permit of the highway commission, and then only in accordance with the regulations of said commission; and the work shall be done under the supervision and to the satisfaction of said commission, and the entire expense of replacing the highway in as good condition as before shall be paid by the persons to whom the permit was given or by whom the work was done; but a city or town may dig up such state highway without such approval of the highway commission in case of immediate necessity; but in such cases it shall be forthwith replaced in as good condition as before at the expense of the city or town. Said commission shall give suitable names to the state highways, and may change the name of any way which becomes a part of a state highway. They shall erect suitable guide posts at convenient points along state highways.

Names to be given to state highways; guide posts to be erected, etc.

[REVISED LAWS, CHAPTER 6.]

. . . .

Security against mechanics' liens on public buildings. 1878, 209. P. S. 16, § 64. 174 Mass. 335.

SECTION 77. Officers or agents who contract in behalf of the commonwealth for the construction or repair of public buildings or other public works shall obtain sufficient security, by bond or otherwise, for payment by the contractor and sub-contractors for labor performed or furnished and for materials used in such construction or repair; but in order to obtain the benefit of such security, the claimant shall file with such officers or agents, a sworn statement of his claim, within sixty days after the completion of the work.

[REVISED LAWS, CHAPTER 112.]

. . . .

Location of roads proposed to be placed

SECTION 38. If the selectmen of a town and the president of a street railway company make application to the

Massachusetts highway commission, and with the application submit satisfactory plans, profiles and cross-sections of a way which the selectmen, or the county commissioners of the county in which the town lies, have in writing requested the commonwealth to take charge of, said commission shall indicate on such plans and profiles a location and grade for the tracks of said street railway company. If said commission considers said way suitable for a state highway, and said commission and the president of said street railway company agree as to the proportionate part of the cost of constructing it which shall be paid by the commonwealth and by the street railway company, then said commission may pay, out of the appropriations for the construction and repair of state highways, said proportionate part of the damages sustained by a person whose property is injured by the construction of such state highway, and of the cost of grading said road to the lines established by the Massachusetts highway commission. A way which is graded under the provisions of this section shall remain a town way or a highway, subject to all laws relative thereto, until said way is taken charge of as a state highway by the commonwealth.

under control of highway commission. 1901, 414.

SECTION 61. If a public way in which a street railway location has been granted shall be thereafter laid out, taken charge of or constructed by or under the authority of the state highway commission, said commission shall thereafter, relative to the location and maintenance of street railways upon such state highway, have the same authority and exercise it in the same manner and subject to the same provisions as is conferred by the provisions of sections seven, eleven, thirty, thirty-one, thirty-two and forty-four upon boards of aldermen and selectmen, but subject to the same rights of abutters and of the street railway company, as is provided in section seven with respect to the relocation and maintenance of street railways in other public ways which are not under the charge of said commission.

Supervision by state highway commission. 1898, 578, § 24.

APPROPRIATIONS FOR THE CONSTRUCTION AND REPAIR OF STATE HIGHWAYS.

1894, chapter 497, section 8,	$300,000 00
1895, chapter 347, section 3,	400,000 00
1896, chapter 481, section 3,	600,000 00
1897, chapter 340, section 1,	800,000 00
1898, chapter 539, section 1,	400,000 00
1899, chapter 396, section 1,	500,000 00
1900, chapter 442, section 1,	500,000 00
1901, chapter 269, section 1,	500,000 00
Total,	$4,000,000 00

APPROPRIATIONS FOR THE SALARIES AND EXPENSES OF THE COMMISSION, PAID FROM THE TREASURY OF THE COMMONWEALTH.

1898,[1] chapter 579, section 1,	[2] $14,300 00
1899, chapter 367, section 1,	28,500 00
1900, chapter 141, section 1,	28,500 00
1901, chapter 451, section 1,	33,750 00

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[1] Previous to 1898 the salaries and expenses of the commission were paid out of the State highway loan fund.

[2] This appropriation bill was approved June 28, 1898, and the amount named was for the remainder of the year.

APPENDIX G.

COST PER MILE OF ROAD (SECTIONS LAID OUT AND CONSTRUCTED DURING 1901).

TOWN OR CITY.	Square Yards.	Miles.	Cost per Mile.
Abington,	4,101	.48	$10,316 15
Acton (west),	6,833	.72	11,497 86
Acton (great road),	4,666	.64	8,050 96
Acushnet,	15,567	1.77	1,575 31
Amesbury,	4,962	.56	10,423 36
Attleborough,[1]	10,580	1.20	3,475 50
Barnstable,	7,000	1.00	2,142 68
Belchertown,	5,846	.66	7,153 50
Brewster (1),	21,000	2.50	1,212 05
Brewster (2),	24,650	2.80	1,499 92
Chatham,	6,000	.68	2,788 97
Chelmsford,	4,588	.51	8,675 43
Chester,	4,295	.49	11,444 82
Concord,	4,648	.53	7,868 00
Dartmouth,[2]	5,300	.46	12,446 58
Deerfield,	3,833	.44	10,605 02
Dennis,	2,951	.31	7,059 85
Edgartown,	3,210	.36	5,730 86
Gardner,	5,583	.60	8,720 42
Hardwick,	3,900	.43	9,987 42
Lunenburg,	3,528	.40	11,815 67
Marion,	3,069	.35	5,694 84
Merrimac,	5,667	.64	8,046 72
Methuen,	4,165	.52	8,817 48
Natick-Wellesley,	21,250	2.32	5,480 58
Newbury,	6,166	.70	6,327 44
Newton,	9,082	1.08	6,363 95
North Adams,	4,220	.46	10,559 13
North Reading,	6,625	.75	7,037 80
Orange-Erving,	10,895	1.23	8,394 19
Palmer,[3]	4,221	.43	11,179 84
Palmer-Monson,	4,740	.60	10,854 62
Princeton,	4,416	.50	9,980 84
Provincetown,	1,917	.22	3,619 64
Richmond,[1]	3,608	.41	6,438 46
Salem,[1]	1,167	.13	9,470 85

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[1] Gravel road. [2] Macadam, 18 feet in width. [3] Includes cost of repairing two bridges.

COST PER MILE OF ROAD, ETC. — *Concluded.*

TOWN OR CITY.	Square Yards.	Miles.	Cost per Mile.
Seekonk,[1]	4,567	.52	$3,349 44
Stoneham,	3,417	.39	7,403 18
Sudbury,	13,095	1.48	5,281 65
Sutton,	4,467	.51	9,793 41
Swampscott,[2]	5,008	.46	12,436 69
Uxbridge,	3,970	.50	9,390 80
Warren,[3]	4,200	.47	11,890 91
Wenham,	4,500	.51	8,387 19
West Bridgewater (1),	8,750	.99	4,845 22
West Bridgewater (2),	8,562	.97	4,068 10
West Brookfield,[3]	6,083	.69	14,274 91
Westfield,	7,250	.82	6,181 34
Wilbraham,	1,935	.22	7,395 45
Wrentham,	6,667	.76	5,985 53
Total,	326,210	37.12	-
Average cost per mile,	. . . . .	. . . . .	$6,311 37

[1] Gravel road.

[2] Macadam, 20 feet and 18 feet in width.

[3] Includes cost of constructing new bridge and abutments.

APPENDIX H.

MAINTENANCE.

Table showing the Amounts expended for Repairs and Maintenance and the Cost per Mile per Year on Each Road finished previous to 1902; also the Number of Miles of Road under Maintenance and the Amounts to be assessed upon Municipalities for Maintenance under Chapter 432 of the Acts of 1900.

TOWN OR CITY.	Expended to 1901.	Expended in 1901.	Total.	Total Cost per Mile per Year.	Expended per Mile in 1901.	Length under Maintenance (Miles).	Amount to be assessed on Cities or Towns.
Abington, . . .	-	$3 27	$3 27	$11 28	$4 67	1.18	$3 27
Acton, . . .	$23 95	53 60	77 55	20 85	12 92	4.16	53 60
Acushnet, . . .	591 70	180 37	772 07	321 70	300 61	.60	30 00
Adams, . . .	227 67	152 45	380 12	190 06	267 45	.57	28 50
Amesbury, . .	54 11	137 61	191 72	248 99	269 82	.51	25 50
Andover, . . .	568 86	188 47	757 33	72 20	61 39	3.07	153 50
Ashby, . . .	1,835 51	72 96	1,908 47	119 78	20 44	3.57	72 96
Ashfield, . . .	403 34	303 02	706 36	142 70	188 21	1.61	80 50
Athol, . . .	4,254 80	38 01	4,292 81	533 27	23 61	1.61	38 01
Attleborough, . .	-	4 69	4 69	5 10	4 69	1.00	4 69
Auburn, . . .	793 23	424 34	1,217 57	102 92	138 22	3.07	153 50
Barnstable, . .	302 86	198 10	500 96	100 39	110 67	1.79	89 50
Barre, . . .	56 71	28 00	84 71	20 61	17 18	1.63	28 00
Bedford, . . .	34 25	25 29	59 54	30 69	46 83	.54	25 29
Belchertown, . .	-	3 11	3 11	14 14	4 64	.67	3 11
Beverly, . . .	732 65	146 03	878 68	96 24	72 65	2.01	100 50
Blackstone, . .	87 06	15 39	102 45	66 10	13 15	1.17	15 39
Bourne, . . .	203 50	137 04	340 54	79 75	96 51	1.42	71 00
Boxborough, . .	124 83	36 62	161 45	38 62	26 92	1.36	36 62
Braintree, . . .	-	2 14	2 14	9 30	4 65	.46	2 14
Brewster, . . .	1,059 30	215 18	1,274 48	95 11	27 62	7.79	215 18

Table showing the Amounts expended for Repairs, etc. — Continued.

TOWN OR CITY.	Expended to 1901.	Expended in 1901.	Total.	Total Cost per Mile per Year.	Expended per Mile in 1901.	Length under Maintenance (Miles).	Amount to be assessed on Cities or Towns.
Brimfield, . . .	$325 21	$127 30	$452 51	$74 80	$54 40	2.34	$117 00
Brockton, . . .	261 58	92 53	354 11	64 38	36 72	2.52	92 53
Brookfield, . .	205 12	165 16	370 28	112 55	118 82	1.39	69 50
Buckland, . . .	597 11	358 24	955 35	75 52	102 35	3.50	175 00
Charlemont, . .	354 66	180 21	534 87	221 94	234 04	.77	38 50
Chatham, . . .	135 05	54 25	189 30	132 38	41 10	1.32	54 25
Chelmsford, . .	211 17	67 97	279 14	108 19	47 20	1.44	67 97
Cheshire, . . .	4 70	151 53	156 23	82 66	106 71	1.42	71 00
Chester, . . .	128 79	216 42	345 21	328 77	327 91	.66	33 00
Chicopee, . . .	845 66	497 79	1,343 45	480 59	535 26	.93	46 50
Cohasset, . . .	109 88	33 50	143 38	44 39	19 36	1.73	33 50
Colrain, . . .	158 51	150 93	309 44	122 79	139 75	1.08	54 00
Concord, . . .	196 75	57 13	253 88	48 36	28 71	1.99	57 13
Cottage City, . .	2,691 25	465 70	3,156 95	237 86	196 49	2.37	118 50
Dalton, . . .	2,061 54	608 11	2,669 65	342 26	389 81	1.56	78 00
Dartmouth, . .	213 10	73 03	286 13	75 70	27 25	2.68	73 03
Deerfield, . . .	1,063 71	103 27	1,166 98	141 11	52 42	1.97	98 50
Dennis, . . .	1,345 24	387 80	1,733 04	93 73	69 62	5.57	278 50
Duxbury, . . .	498 49	128 40	626 89	68 96	62 63	2.05	102 50
Easthampton, . .	474 58	42 54	517 12	66 73	17 87	2.38	42 54
Easton, . . .	–	10 62	10 62	13 79	13 28	.80	10 62
Edgartown, . .	126 85	62 92	189 77	87 45	41 39	1.52	62 92
Erving, . . .	62 67	143 97	206 64	64 98	70 57	2.04	102 00
Fairhaven, . . .	252 50	176 35	428 85	47 92	121 62	1.45	72 50
Fitchburg, . . .	451 88	81 60	533 48	62 83	37 77	2.16	81 60
Gardner, . . .	570 18	189 96	760 14	93 38	56 70	3.35	167 50
Gloucester, . .	826 60	294 84	1,121 44	99 68	118 89	2.48	124 00
Goshen, . . .	1,539 16	53 81	1,592 97	143 38	28 17	1.91	53 81
Grafton, . . .	148 89	236 05	384 94	95 76	152 29	1.55	77 50
Granby, . . .	603 84	55 06	658 90	167 23	87 40	.63	31 50
Great Barrington, .	2,731 78	671 08	3,402 76	254 70	240 51	2.79	139 50
Greenfield, . .	2 92	78 66	81 58	60 43	79 45	.99	49 50
Hadley, . . .	2,145 86	317 67	2,463 53	219 57	116 36	2.73	136 50
Hamilton, . . .	3 28	88 19	91 47	46 67	61 24	1.44	72 00

Table showing the Amounts expended for Repairs, etc. — Continued.

TOWN OR CITY.	Expended to 1901.	Expended in 1901.	Total.	Total Cost per Mile per Year.	Expended per Mile in 1901.	Length under Maintenance (Miles).	Amount to be assessed on Cities or Towns.
Hancock, . . .	$2,426 16	$596 76	$3,022 92	$267 75	$184 75	3.23	$161 50
Hardwick, . . .	102 92	36 72	139 64	94 35	44 78	.82	36 72
Harvard, . . .	-	3 28	3 28	14 26	4 68	.70	3 28
Harwich, . . .	126 35	101 64	227 99	78 31	40 17	2.53	101 64
Haverhill, . . .	2 00	16 53	18 53	4 64	7 95	2.08	16 53
Hingham, . . .	656 81	117 51	774 32	55 67	44 17	2.66	117 51
Holbrook, . . .	297 01	35 98	332 99	58 63	32 42	1.11	35 98
Holden, . . .	769 30	261 37	1,030 67	61 42	69 51	3.76	188 00
Huntington, . .	1,153 74	412 32	1,566 06	322 90	408 23	1.01	50 50
Lawrence, . . .	86 89	1,184 14	1,271 03	1,086 85	4,385 70	.27	13 50
Lee, ...	1,268 95	405 36	1,674 31	142 49	125 11	3.24	162 00
Leicester, . . .	8,860 51	379 16	9,239 67	505 18	78 18	4.85	242 50
Lenox, . . .	163 29	682 73	846 02	571 64	299 44	2.28	114 00
Lexington, . .	524 13	125 93	650 06	42 74	29 36	4.29	125 93
Lincoln, . . .	389 40	72 84	462 24	46 36	35 19	2.07	72 84
Lowell (north), .	225 37	25 12	250 49	236 16	643 57	2.31	115 50
Lowell (south), .	332 49	1,455 10	1,787 59				
Lunenburg, . .	97 42	225 62	323 04	106 26	122 62	1.84	92 00
Marion, . . .	362 66	110 58	473 24	37 56	34 45	3.21	110 58
Marlborough, . .	175 39	126 51	301 90	65 77	59 96	2.11	105 50
Marshfield, . .	277 00	120 98	397 98	51 96	60 49	2.00	100 00
Mattapoisett, . .	307 66	119 30	426 96	53 37	60 25	1.98	99 00
Merrimac, . . .	107 54	166 34	273 88	89 50	180 80	.92	46 00
Methuen, . . .	249 36	143 72	393 08	80 55	86 58	1.66	83 00
Middleborough, .	484 54	71 76	556 30	40 46	26 00	2.76	71 76
Milton, . . .	21 11	1,210 34	1,231 45	1,558 80	1,391 19	.87	43 50
Monson, . . .	540 40	95 22	635 62	113 91	102 38	.93	46 50
Montague, . . .	244 77	13 62	258 39	61 96	8 35	1.63	13 62
Nantucket, . .	1,686 92	237 90	1,924 82	83 54	46 02	5.17	237 90
New Braintree, .	10 89	14 51	25 40	43 79	85 35	.17	8 50
Newbury, . . .	2 60	45 56	48 16	46 76	37 34	1.22	45 56
Newburyport, . .	484 44	123 58	608 02	107 23	70 62	1.75	87 50
Norfolk, . . .	292 89	33 91	326 80	45 08	23 38	1.45	33 91
North Adams, . .	1,378 12	132 50	1,510 62	159 52	49 07	2.70	132 50

Table showing the Amounts expended for Repairs, etc. — Continued.

TOWN OR CITY.	Expended to 1901.	Expended in 1901.	Total.	Total Cost per Mile per Year.	Expended per Mile in 1901.	Length under Maintenance (Miles).	Amount to be assessed on Cities or Towns.
North Andover, .	-	$90 21	$90 21	$114 19	$114 19	.79	$39 50
Northampton, . .	$479 03	42 96	521 99	79 57	25 57	1.68	42 96
North Attleborough,	482 44	906 29	1,388 73	80 46	251 75	3.60	180 00
Northborough, . .	108 84	123 03	231 87	42 94	55 91	2.20	110 00
North Reading, .	67 51	4 72	72 23	23 87	2 68	1.76	4 72
Norwood, . . .	398 45	173 83	572 28	68 29	84 79	2.05	102 50
Orange, . . .	1,204 78	69 92	1,274 70	122 57	23 23	3.01	69 92
Orleans, . . .	-	32 59	32 59	39 74	39 74	.82	32 59
Palmer, . . .	5 25	138 30	143 55	51 64	55 10	2.51	125 50
Paxton, . . .	1,530 62	237 87	1,768 49	104 27	73 42	3.24	162 00
Phillipston, . .	244 63	91 82	336 45	99 25	77 16	1.19	59 50
Pittsfield, . . .	1,822 51	560 12	2,382 63	211 60	242 47	2.36	118 00
Plymouth, . . .	1,997 66	546 05	2,543 71	140 92	141 83	3.85	192 50
Princeton, . . .	173 75	4 64	178 39	82 20	4 64	1.00	4 64
Provincetown, . .	-	1 01	1 01	12 62	4 59	.22	1 01
Quincy, . . .	2 46	22 41	24 87	38 26	45 73	.49	22 41
Reading, . . .	26 12	133 49	159 61	118 23	124 75	1.07	53 50
Rehoboth, . . .	464 43	39 77	504 20	62 82	21 05	1.89	39 77
Revere (east), . .	275 50	139 64	415 14	486 76	713 35	1.25	62 50
Revere (west), . .	229 82	752 05	981 87				
Richmond, . .	212 12	494 56	706 68	188 45	279 41	1.77	88 50
Russell, . . .	2,955 27	938 83	3,894 10	146 56	140 96	6.66	333 00
Sandwich, . . .	848 30	117 46	965 76	146 11	45 88	2.56	117 46
Saugus, . . .	278 26	346 33	624 59	260 24	216 46	1.60	80 00
Scituate, . . .	458 30	179 44	637 74	104 20	101 38	1.77	88 50
Seekonk, . . .	-	2 65	2 65	9 14	4 65	.57	2 65
Shelburne, . .	911 67	52 65	964 32	84 81	24 38	2.16	52 65
Shrewsbury, . .	554 67	368 45	923 12	65 84	94 47	3.90	195 00
Somerset, . . .	416 86	146 97	563 83	46 03	40 94	3.59	146 97
South Hadley, . .	1,166 38	297 66	1,464 04	201 38	123 00	2.42	121 00
Spencer, . . .	-	78 58	78 58	73 44	49 42	1.59	78 58
Sterling, . . .	221 95	161 05	383 00	95 75	124 84	1.29	64 50
Stoneham, . .	284 97	38 70	323 67	129 98	24 49	1.58	38 70
Sturbridge, . .	79 59	83 99	163 58	80 98	142 35	.59	29 50

Table showing the Amounts expended for Repairs, etc. — Continued.

TOWN OR CITY.	Expended to 1901.	Expended in 1901.	Total.	Total Cost per Mile per Year.	Expended per Mile in 1901.	Length under Maintenance (Miles).	Amount to be assessed on Cities or Towns.
Sudbury, . . .	$107 87	$21 08	$128 95	$37 59	$7 32	2.88	$21 08
Sunderland, . .	20 58	88	21 41	35 10	4 63	.19	88
Sutton, . . .	2 44	69 56	72 00	67 29	69 56	1.00	50 00
Swampscott, . .	411 42	61 14	472 56	139 81	41 03	1.49	61 14
Taunton, . . .	870 44	59 55	929 99	108 90	27 96	2.13	59 55
Templeton, . .	75 70	42 74	118 44	34 60	67 84	.63	31 50
Tewksbury, . .	2 82	23 30	26 12	36 79	40 88	.57	23 30
Tisbury, . . .	833 15	113 96	947 11	77 50	59 05	1.93	96 50
Townsend, . .	271 11	131 96	403 07	55 37	44 58	2.96	131 96
Truro, . . .	307 74	220 56	528 30	82 67	93 46	2.36	118 00
Tyngsborough, . .	923 04	95 51	1,018 55	78 17	32 38	2.95	95 51
Uxbridge, . . .	127 28	147 96	275 24	74 79	83 12	1.78	89 00
Walpole, . . .	871 12	275 29	1,146 41	67 71	60 64	4.54	227 00
Ware, . . .	207 32	80 73	288 05	85 98	44 85	1.80	80 73
Wareham, . .	209 39	26 48	235 87	36 12	16 35	1.62	26 48
Warren, . . .	564 89	150 29	715 18	87 32	61 09	2.46	123 00
Watertown, . .	753 08	214 14	967 22	220 32	251 93	.85	42 50
Wayland, . . .	58 21	196 02	254 23	66 90	86 35	2.27	113 50
Wenham, . . .	155 44	50 86	206 30	83 18	45 41	1.12	50 86
Westborough, . .	132 93	13 99	146 92	58 53	19 98	.70	13 99
West Boylston, .	585 47	24 54	610 01	128 42	15 84	1.55	24 54
West Bridgewater, .	–	4 64	4 64	12 54	4 69	.99	4 64
West Brookfield, .	4 80	32 35	37 15	23 07	33 35	.97	32 35
Westfield, . . .	2,069 36	355 23	2,424 59	144 66	72 35	4.91	245 50
Westminster, . .	870 89	81 69	952 58	76 95	27 23	3.00	81 69
West Newbury, .	1,629 37	198 08	1,827 45	176 90	88 43	2.24	112 00
Weston, . . .	182 86	126 63	309 49	49 12	40 20	3.15	126 63
Westport, . . .	1,732 05	826 48	2,558 53	126 91	194 47	4.25	212 50
West Springfield, .	665 10	181 23	846 33	144 67	157 59	1.15	57 50
West Tisbury, . .	492 98	121 34	614 32	47 92	42 73	2.84	121 34
Westwood, . .	73 14	75 28	148 42	106 00	71 69	1.05	52 50
Weymouth, . .	648 67	123 99	772 66	90 69	62 00	2.00	100 00
Whately, . . .	3 87	12 04	15 91	15 30	15 44	.78	12 04
Whitman, . . .	325 82	180 13	505 95	52 65	106 58	1.69	84 50

Table showing the Amounts expended for Repairs, etc. — Concluded.

TOWN OR CITY.	Expended to 1901.	Expended in 1901.	Total.	Total Cost per Mile per Year.	Expended per Mile in 1901.	Length under Maintenance (Miles).	Amount to be assessed on Cities or Towns.
Wilbraham, . .	$729 22	$34 06	$763 28	$81 72	$15 92	2.14	$34 06
Williamsburg, . .	364 11	80 48	444 59	87 86	37 96	2.12	80 48
Williamstown, . .	597 69	163 78	761 47	97 87	85 30	1.92	96 00
Winchester, . .	94 33	340 64	434 97	144 03	174 69	1.95	97 50
Windsor, . . .	17 91	1 33	19 24	21 62	4 75	.28	1 33
Worcester, . .	845 41	150 03	995 44	117 11	58 83	2.55	127 50
Wrentham, . .	645 89	148 97	794 86	47 54	27 38	5.44	148 97
Yarmouth (north), .	909 47	241 97	1,151 44	59 29	65 22	3.71	185 50
Yarmouth (south), .	1,647 12	449 85	2,096 97	91 41	88 55	5.08	254 00
Totals, . .	$96,755 86	$31,061 47	$127,816 83	-	-	-	$13,639 00

APPENDIX J.

STATEMENT SHOWING ALL PETITIONS RECEIVED, WITH LENGTHS OF WAY PETITIONED FOR AND LAY-OUTS MADE, TOGETHER WITH SUMMARY BY COUNTIES.

Barnstable County.

COUNTY, CITY OR TOWN.	No.	Petition received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
					1894-1900.		1901.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Barnstable,[1],[2]	125	July 31, 1895,	10,548	2.00	-	-	-	-
Barnstable,[2],[3]	231	Feb. 13, 1896,	7,700	1.46	4,452	.84	2,200	.42
Barnstable,[1],[4]	418	Apr. 23, 1898,	10,560	2.00	5,000	.95	-	-
Barnstable,[3]	546	Apr. 8, 1901,	5,280	1.00	-	-	5,295	1.00
Barnstable,[5]	557	Oct. 24, 1901,	13,200	2.50	-	-	-	-
Barnstable,[6]	559	Nov. 14, 1901,	9,200	1.75	-	-	-	-
Bourne,[7]	124	Jan. 29, 1895,	16,125	3.05	-	-	-	-
Bourne,[8]	338	May 1, 1897,	7,470	1.42	7,470	1.42	-	-
Bourne,[9]	445	Dec. 19, 1898,	27,000	5.11	-	-	-	-
Brewster, ...	118	Jan. 15, 1895,	40,982	7.76	13,117	2.49	27,992	5.30
Chatham,[3]	155	Apr. 4, 1895,	10,639	2.01	3,114	.59	3,600	.68
Chatham,[3]	510	Jan. 3, 1901,	10,560	2.00	-	-	-	-
Dennis,[1]	102	Nov. 27, 1894,	22,514	4.27	22,511	4.27	-	-
Dennis,[3]	126	Feb. 6, 1895,	17,224	3.26	5,282	1.00	1,617	.31
Eastham, ...	209	Aug. 5, 1895,	34,144	6.47	-	-	-	-
Falmouth, ...	547	Apr. 29, 1901,	93,720	17.75	-	-	-	-
Harwich,[10]	106	Dec. 22, 1894,	26,150	4.95	11,850	2.15	2,000	.38
Harwich,[3]	514	Jan. 14, 1901,	14,520	2.75	-	-	-	-
Mashpee, ...	515	Jan. 14, 1901,	22,440	4.25	-	-	-	-
Orleans,[1]	182	May 27, 1895,	10,440	1.98	4,348	.82	2,246	.42
Orleans,[11]	479	Dec. 14, 1899,	13,725	2.60	-	-	-	-
Provincetown,[12] . . .	186	June 4, 1895,	14,790	2.80	-	-	-	-
Provincetown,[12] . . .	504	Nov. 9, 1900,	1,200	.23	-	-	1,150	.22
Sandwich,[1],[13] . . .	98	Nov. 23, 1894,	9,000	1.70	9,000	1.70	-	-
Sandwich,[1]	430	July 15, 1895,	6,382	1.21	4,500	.85	-	-
Sandwich,[1],[14] . . .	516	Jan. 17, 1901,	21,806	4.13	-	-	-	-
Truro,[15]	95	Oct. 22, 1894,	12,478	2.36	12,478	2.36	-	-
Truro,[16]	386	Dec. 1, 1897,	20,300	3.84	-	-	-	-
Wellfleet,[17],[18] . . .	229	Jan. 30, 1896,	-	-	-	-	-	-
Wellfleet,[17]	483	Feb. 19, 1900,	35,640	6.75	-	-	-	-
Yarmouth,[1]	90	Sept. 28, 1894,	19,634	3.72	19,585	3.71	-	-
Yarmouth,[3]	100	Nov. 26, 1894,	26,900	5.10	26,825	5.08	-	-
Totals, ...	.	. . . .	592,271	112.17	149,032	28.23	46,100	8.73

Thirty-two petitions, in fifteen towns.
Average distance petitioned for, 18,508 feet (3.51 miles).
Forty-seven lay-outs, in eleven towns; all on town petitions.
Total length laid out, 195,132 feet (36.96 miles); average, 4,152 feet (.79 mile).
Percentage of length laid out to length petitioned for, 32.89.

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[1] North county road.
[2] From Yarmouth line.
[3] South county road
[4] From Sandwich line.
[5] Cotuit road, from Marston's Mills.
[6] Falmouth road, from Marston's Mills.
[7] Plymouth line to Sandwich line.
[8] Bourne Village to Wareham line.
[9] Bourne Village to Sandwich line.
[10] South county road and road to Harwich Centre.
[11] Chatham road.
[12] Truro road.
[13] From Barnstable line.
[14] From Bourne line.
[15] Wellfleet line to Kelly's Corner.
[16] North Truro to Kelly's Corner.
[17] County road.
[18] Included in subsequent petition.

Berkshire County.

County, City or Town.	No.	Petition received.	Length petitioned for.		Length laid out.			
					1894-1900.		1901.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Adams,[1],[2]	48	July 18, 1894,	9,020	1.71	-	-	-	-
Adams,[3]	279	July 30, 1896,	5,280	1.00	3,000	.57	-	-
Adams,[4]	376	Oct. 16, 1897,	12,628	2.39	-	-	-	-
Becket,[5],[6]	117	Jan. 12, 1895,	-	-	-	-	-	-
Becket,[5]	440	Dec. 16, 1898,	53,480	10.12	-	-	-	-
Becket,[7]	561	Dec. 6, 1901,	34,320	6.50	-	-	-	-
Berkshire County,[8]	46	July 18, 1894,	-	-	-	-	-	-
Berkshire County,[9]	47	July 18, 1894,	-	-	-	-	-	-
Berkshire County,[10]	82	Aug. 13, 1894,	-	-	-	-	-	-
Berkshire County,[11]	83	Aug. 13, 1894,	-	-	-	-	-	-
Berkshire County,[12]	170	May 10, 1895,	-	-	-	-	-	-
Berkshire County,[11]	187	June 6, 1895,	-	-	-	-	-	-
Berkshire County,[13]	275	July 25, 1896,	-	-	-	-	-	-
Berkshire County,[14]	276	July 25, 1896,	-	-	-	-	-	-
Berkshire County,[15]	277	July 25, 1896,	-	-	-	-	-	-
Berkshire County,[16]	278	July 25, 1896,	-	-	-	-	-	-
Berkshire County,[12]	298	Sept. 21, 1896,	-	-	-	-	-	-
Berkshire County,[12]	330	Mar. 9, 1897,	-	-	-	-	-	-
Berkshire County,[17]	415	April 7, 1898,	-	-	-	-	-	-
Berkshire County,[18]	484	Oct. 5, 1898,	-	-	-	-	-	-
Berkshire County,[19]	485	Oct. 5, 1898,	-	-	-	-	-	-
Cheshire,[2],[20]	46	- -	3,280	.62	-	-	-	-
Cheshire,[6],[21]	331	Mar. 11, 1897,	-	-	7,500	1.42	-	-
Cheshire,[21]	410	Dec. 16, 1899,	34,300	6.50	-	-	2,400	.46
Clarksburg,	431	July 26, 1898,	5,280	1.00	-	-	-	-
Dalton,[22]	26	June 10, 1894,	-	-	-	-	-	-
Dalton,[22]	176	May 14, 1895,	6,314	1.20	5,459	1.03	-	-
Dalton,[22]	238	April 1, 1896,	5,190	.98	2,800	.53	-	-
Dalton,[22]	313	Jan. 29, 1897,	3,200	.63	-	-	-	-
Dalton,[5]	340	May 18, 1897,	5,450	1.04	-	-	-	-
Florida,	74	Aug. 1, 1894,	26,853	5.09	-	-	-	-
Great Barrington,[20],[23]	82	- -	10,560	2.00	10,560	2.00	-	-
Great Barrington,[23]	267	June 18, 1896,	10,284	1.95	4,146	.79	-	-
Hancock,[20],[24]	170	- -	6,289	1.19	6,200	1.18	-	-
Hancock,[20],[24]	298	- -	9,938	1.88	8,242	1.56	-	-
Hancock,[20],[24]	330	- -	2,574	.49	2,574	.49	-	-
Hinsdale,[22]	156	Apr. 6, 1895,	5,624	1.07	-	-	2,100	.40
Hinsdale,[5],[6]	523	Feb. 12, 1901,	-	-	-	-	-	-
Hinsdale,[5]	560	Nov. 21, 1901,	29,040	5.50	-	-	-	-
Lanesborough,[20],[25]	278	- -	5,280	1.00	-	-	-	-

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[1] Duplicate of county petition.
[2] Cheshire-Savoy road.
[3] Maple Grove road.
[4] North Adams road.
[5] Pittsfield-Springfield road.
[6] Covered by subsequent petition.
[7] To Becket Centre and North Becket.
[8] See Adams.
[9] See North Adams.
[10] See Great Barrington.
[11] See Lee.
[12] See Hancock.
[13] See Otis.
[14] See Savoy.
[15] See Cheshire.
[16] See Lanesborough.
[17] See West Stockbridge.
[18] See Richmond.
[19] See Tyringham.
[20] On county petition.
[21] Pittsfield-North Adams road.
[22] Pittsfield-Northampton road.
[23] Monterey road.
[24] Lebanon Springs road.
[25] Road to Williamstown.

Berkshire County — Concluded.

County, City or Town.	No.	Petition received.	Length petitioned for.		Length laid out.			
					1894-1900.		1901.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Lanesborough,[1]	549	June 7, 1901,	11,880	2.25	-	-	-	-
Lee,[2],[3]	83	- -	5,280	1.00	5,188	.98	-	-
Lee,[2],[3]	187	- -	5,280	1.00	5,292	1.00	-	-
Lee,[4]	252	May 25, 1896,	5,280	1.00	-	-	-	-
Lee,[5]	348	June 14, 1897,	6,762	1.28	6,645	1.26	-	-
Lenox,[6]	178	May 16, 1895,	5,280	1.00	-	-	5,280	1.00
Lenox,[6]	316	Feb. 7, 1897,	6,770	1.28	6,396	1.21	370	.07
Monterey,	256	June 5, 1896,	5,280	1.00	-	-	-	-
Mount Washington,	92	Oct. 1, 1894,	8,300	1.57	-	-	-	-
North Adams,[3],[7]	47	- -	9,028	1.71	8,913	1.69	-	-
North Adams,[7]	254	May 27, 1896,	5,807	1.10	-	-	-	-
North Adams,[1]	393	Dec. 22, 1897,	12,436	2.36	2,870	.55	2,465	.46
Otis,	275	- -	5,280	1.00	-	-	-	-
Pittsfield,[8]	78	Aug. 7, 1894,	24,087	4.56	8,145	1.54	1,953	.37
Pittsfield,[9]	259	June 10, 1896,	6,000	1.13	4,040	.76	-	-
Richmond,[10]	198	June 4, 1895,	10,462	1.98	-	-	-	-
Richmond,[11]	248	May 9, 1896,	5,300	1.00	5,280	1.00	-	-
Richmond,[11],[8]	434	- -	12,900	2.44	1,911	.36	1,260	.24
Sandisfield,	459	Mar. 13, 1899,	5,280	1.00	-	-	-	-
Savoy,	276	- -	5,280	1.00	-	-	-	-
Stockbridge,[12]	136	Feb. 26, 1895,	10,700	2.02	-	-	-	-
Stockbridge,[13]	507	Dec. 2, 1900,	-	-	-	-	-	-
Tyringham,	435	- -	5,500	1.04	-	-	-	-
West Stockbridge,	166	Sept. 30, 1895,	6,146	1.16	-	-	-	-
Williamstown,[14]	145	Mar. 10, 1895,	10,576	2.00	10,147	1.92	-	-
Williamstown,[15]	462	Apr. 17, 1899,	12,600	2.38	-	-	-	-
Windsor,	36	July 12, 1894,	42,787	8.10	1,501	.28	-	-
Totals,	.	. . .	534,415	101.22	116,809	22.12	15,828	3.00

Fifty-four petitions (fifteen county, four city and thirty-five town), in two cities and twenty-three towns.

Average distance petitioned for, 9,896 feet (1.87 miles).

Forty-one lay-outs, in two cities and eleven towns.

Laid out on county petitions, 50,140 feet (9.50 miles).

Laid out on city petitions, 19,473 feet (3.69 miles).

Laid out on town petitions, 63,024 feet (11.93 miles).

Total length laid out, 132,637 feet (25.12 miles); average, 3,235 feet (.61 mile).

Percentage of length laid out to length petitioned for, 24.82.

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[1] Pittsfield-North Adams road.

[2] Pittsfield-Springfield road.

[3] On county petition.

[4] South Lee road.

[5] Lenox road.

[6] Lee road.

[7] Road to Williamstown.

[8] Lebanon Springs road.

[9] Dalton road.

[10] Hancock road.

[11] East road to Pittsfield.

[12] Old Housatonic Turnpike.

[13] Duplicate of former petition.

[14] North Adams road.

[15] Water Street.

Bristol County.

COUNTY, CITY OR TOWN.	No.	Petition received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
					1894-1900.		1901.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Acushnet,[1] . . .	96	Oct. 24, 1894,	35,500	6.73	3,363	.64	9,340	1.77
Acushnet,[2] . . .	97	Oct. 24, 1894,	6,326	1.20	-	-	-	-
Attleborough,[3] . .	183	May 29, 1895,	14,153	2.68	-	-	-	-
Attleborough,[4] . .	184	May 29, 1895,	5,122	.97	-	-	-	-
Attleborough,[3],[5] . .	268	June 18, 1896,	-	-	5,297	1.00	6,350	1.20
Attleborough,[3],[5] . .	508	Dec. 6, 1900,	-	-	-	-	-	-
Berkley, ...	281	Aug. 8, 1896,	22,650	4.29	-	-	-	-
Bristol County,[6] . .	53	July 24, 1894,	-	-	-	-	-	-
Dartmouth,[7] . . .	22	July 9, 1894,	24,000	4.55	11,725	2.22	2,450	.46
Dighton,[8]	150	Mar. 26, 1895,	24,576	4.65	-	-	-	-
Dighton,[9]	226	Jan. 2, 1896,	8,261	1.56	-	-	-	-
Easton,[10]	139	Mar. 1, 1895,	39,000	7.39	-	-	-	-
Easton,[11]	365	Sept. 2, 1897,	4,300	.81	4,229	.80	-	-
Fairhaven, . . .	31	July 10, 1894,	20,184	3.81	7,653	1.45	-	-
Freetown, . . .	314	Feb. 8, 1897,	16,850	3.20	-	-	-	-
Mansfield,[12] . . .	341	Apr. 8, 1897,	5,121	.97	-	-	-	-
Mansfield,[13] . . .	527	Feb. 25, 1901,	14,520	2.75	-	-	3,800	.72
New Bedford, . . .	191	June 18, 1895,	2,950	.56	-	-	-	-
North Attleborough, .	18	July 5, 1894,	25,550	4.83	18,992	3.60	-	-
Raynham,[10] . . .	134	Feb. 23, 1895,	23,000	4.36	-	-	-	-
Raynham,[14] . . .	511	Jan. 5, 1901,	22,440	4.25	-	-	3,228	.61
Rehoboth,[9] . . .	132	Feb. 20, 1895,	29,187	5.53	9,998	1.89	-	-
Rehoboth,[15] . . .	476	June 19, 1899,	9,240	1.75	-	-	-	-
Seekonk,[9] . . .	127	Feb. 6, 1896,	14,591	2.76	3,000	.57	2,700	.51
Seekonk,[16] . . .	555	Sept. 12, 1901,	10,560	2.00	-	-	-	-
Somerset,[8] . . .	147	Mar. 30, 1895,	29,800	5.64	18,981	3.59	2,158	.41
Somerset,[17] . . .	526	Feb. 15, 1901,	1,172	.22	-	-	1,172	.22
Swansea, ...	235	Mar. 10, 1896,	36,515	6.92	-	-	-	-
Taunton,[18] . . .	171	May 11, 1895,	25,864	4.89	-	-	-	-
Taunton,[9]	179	May 16, 1895,	23,752	4.50	14,400	2.73	1,084	.21
Taunton,[10] . . .	180	May 19, 1895,	13,200	2.50	-	-	-	-
Westport,[19] . . .	53	- -	24,100	4.57	22,459	4.25	-	-
Totals, . . .	.	. . .	532,484	100.84	120,092	22.74	32,282	6.11

Thirty-one petitions (one county, four city and twenty-six town), in two cities and sixteen towns.
Average distance petitioned for, 17,175 feet (3.25 miles).
Forty-five lay-outs, in one city and twelve towns.
Laid out on county petitions, 36,634 feet (6.94 miles).
Laid out on city petitions, 15,484 feet (2.93 miles).
Laid out on town petitions, 100,256 feet (18.99 miles).
Total length laid out, 152,374 feet (28.86 miles); average, 3,386 feet (.64 mile).
Percentage of length laid out to length petitioned for, 28.62.

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[1] New Bedford-Boston road.
[2] Fairhaven road.
[3] Washington Street.
[4] North Avenue.
[5] Covered by previous petition.
[6] See Dartmouth and Westport.
[7] Duplicate of county petition.
[8] Taunton-Fall River road.
[9] Taunton-Providence Turnpike.
[10] Taunton-Boston road.
[11] Brockton-Mansfield road.
[12] South Main Street, from Norton line.
[13] Central, West and Main streets.
[14] Main Street.
[15] Town house road.
[16] Perrin's station road.
[17] Relocation.
[18] Somerset Avenue, Bow, Spring and Dean streets.
[19] On county petition.

Dukes County.

COUNTY, CITY OR TOWN.	No.	Petition received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
					1894-1900.		1901.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Chilmark, . . .	12	July 3, 1894,	38,345	7.26	-	-	-	-
Cottage City,[1],[2] . .	7	- -	13,117	2.48	12,538	2.37	-	-
Cottage City,[1],[3] . .	335	- -	2,150	.41	-	-	-	-
Dukes County,[4] . .	7	July 2, 1894,	-	-	-	-	-	-
Dukes County,[5] . .	335	Mar. 27, 1897,	-	-	-	-	-	-
Edgartown,[1] . . .	7	- -	13,100	2.48	5,356	1.01	2,763	.52
Tisbury,[6]	3	June 28, 1894,	10,609	2.01	10,194	1.93	-	-
Tisbury,[1],[7] . . .	335	- -	4,769	.90	-	-	-	-
West Tisbury,[6] . .	4	June 28, 1894,	31,833	5.94	15,000	2.84	-	-
West Tisbury,[8] . .	244	May 29, 1896,	6,300	1.19	-	-	-	-
Totals, . . .	.	. . .	119,723	22.67	43,088	8.16	2,763	.52

Six petitions (two county and four town), in five towns.
Average distance petitioned for, 19,954 feet (3.78 miles).
Fifteen lay-outs, in four towns.
Laid out on county petitions, 20,657 feet (3.91 miles).
Laid out on town petitions, 25,194 feet (4.77 miles).
Total length laid out, 45,851 feet (8.68 miles); average, 3,057 feet (.58 mile).
Percentage of length laid out to length petitioned for, 38.29.

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[1] On county petition.
[2] Edgartown road.
[3] Vineyard Haven road.
[4] See Cottage City and Edgartown.
[5] See Cottage City and Tisbury.
[6] Gay Head road.
[7] Cottage City road.
[8] Relocation.

Essex County.

COUNTY, CITY OR TOWN.	No.	Petition received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
					1894-1900.		1901.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Amesbury, . . .	203	July 22, 1895,	27,997	5.80	2,674	.51	2,302	.44
Andover,[1] . . .	20	July 6, 1894,	31,400	5.95	16,186	3.06	-	-
Andover,[2],[3] . . .	436	- -	-	-	-	-	-	-
Andover,[4] . . .	442	Dec. 18, 1898,	25,080	4.75	-	-	-	-
Andover,[3],[5] . . .	443	Dec. 18, 1898,	21,750	4.12	-	-	-	-
Beverly,[2]	64	- -	13,900	2.64	10,613	2.01	-	-
Boxford, ...	395	Dec. 23, 1897,	25,125	4.76	-	-	-	-
Danvers,[6]	351	June 29, 1897,	6,267	1.19	-	-	-	-
Danvers,[7]	490	Apr. 11, 1900,	27,450	5.20	-	-	-	-
Danvers,[8]	534	Mar. 28, 1901,	15,840	3.00	-	-	-	-
Danvers,[9]	535	Mar. 28, 1901,	15,840	3.00	-	-	-	-
Essex, ...	364	Aug. 3, 1897,	22,412	4.25	-	-	-	-
Essex County,[10] . .	64	July 30, 1894,	-	-	-	-	-	-
Essex County,[11] . .	436	Oct. 26, 1898,	-	-	-	-	-	-
Georgetown, . . .	390	Dec. 16, 1897,	16,800	3.18	-	-	-	-
Gloucester,[12] . . .	28	July 10, 1894,	9,650	1.83	9,650	1.83	-	-
Gloucester,[13] . . .	110	Jan. 1, 1895,	54,120	10.25	-	-	-	-
Gloucester,[12] . . .	380	Apr. 5, 1897,	8,550	1.62	3,446	.65	-	-
Groveland, . . .	211	Aug. 8, 1895,	23,948	4.53	2,968	.56	1,129	.21
Hamilton,[2] . . .	64	- -	18,100	3.43	7,607	1.44	-	-
Haverhill,[14] . . .	297	Nov. 4, 1896,	13,888	2.63	10,964	2.08	-	-
Haverhill,[15] . . .	471	June 1, 1899,	15,840	3.00	-	-	-	-
Ipswich,[2],[16] . . .	64	- -	12,330	2.34	-	-	-	-
Ipswich,[17] . . .	239	Apr. 4, 1896,	11,900	2.25	-	-	-	-
Lawrence,[18] . . .	76	Aug. 2, 1894,	2,640	.50	-	-	-	-
Lawrence,[19] . . .	245	May 4, 1896,	4,660	.88	-	-	-	-
Lawrence,[18] . . .	284	Aug. 26, 1896,	2,300	.44	-	-	-	-
Lawrence,[20] . . .	285	Aug. 25, 1896,	1,750	.33	-	-	-	-
Lawrence,[21] . . .	290	Sept. 11, 1896,	1,408	.27	1,408	.27	-	-
Lawrence,[2],[22] . . .	436	- -	7,920	1.50	-	-	-	-
Lawrence,[23] . . .	460	Mar. 16, 1899,	1,800	.34	-	-	-	-
Lawrence,[24] . . .	521	Feb. 9, 1901,	1,984	.38	-	-	-	-
Lynn, ...	342	May 20, 1897,	9,120	1.73	4,777	.90	-	-
Manchester, ...	167	May 1, 1895,	5,280	1.00	-	-	-	-
Merrimac, . . .	204	July 26, 1895,	15,134	2.87	4,838	.92	3,400	.64

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[1] Boston-Lawrence road.

[2] On county petition.

[3] Lowell-Lawrence road.

[4] Tewksbury road to Frye village.

[5] Duplicate of county petition.

[6] Sylvan Street.

[7] Locust, Maple, High and Water streets.

[8] Andover Street.

[9] Maple Street.

[10] See Beverly, Wenham, Hamilton and Ipswich.

[11] See Andover and Lawrence.

[12] Western Avenue.

[13] Essex Avenue, Washington Street and Rockport road.

[14] Haverhill-Lawrence road.

[15] Newton road.

[16] South of arch bridge, Newburyport road.

[17] North of arch bridge, Newburyport road.

[18] Haverhill Street.

[19] South Broadway.

[20] Prospect Street.

[21] Jackson Street.

[22] Lowell road, south.

[23] Loring Street.

[24] Barker Street.

Essex County — Concluded.

County, City or Town.	No.	Petition received.	Length petitioned for.		Length laid out			
					1894-1900.		1901.	
			Feet.	Miles.	Feet.	Miles	Feet.	Miles.
Methuen,[1]	287	Aug. 31, 1896,	5,400	1.02	5,478	1.04	-	-
Methuen,[2]	387	Dec. 8, 1897,	5,300	1.00	-	-	-	-
Methuen,[1]	481	Jan. 22, 1900,	13,200	2.50	3,300	.63	2,750	.52
Methuen,[3]	520	Feb. 8, 1901,	3,500	.66	-	-	-	-
Middleton,[4]	347	July 12, 1897,	26,501	5.02	-	-	-	-
Middleton,[5]	531	Mar. 7, 1901,	10,560	2.00	-	-	-	-
Newbury,[6]	197	July 2, 1895,	22,388	4.24	6,453	1.22	4,627	.88
Newbury,[7]	410	Mar. 7, 1898,	23,133	4.38	-	-	-	-
Newburyport,[8]	196	July 1, 1895,	10,100	1.91	9,259	1.75	-	-
Newburyport,[7]	417	Apr. 22, 1898,	2,700	.51	-	-	-	-
North Andover,[9]	272	July 1, 1896,	10,186	1.93	4,175	.79	-	-
North Andover,[10]	522	Feb. 11, 1901,	27,192	5.15	-	-	-	-
Peabody,[11]	352	July 1, 1897,	12,120	2.30	-	-	-	-
Peabody,[12]	353	July 1, 1897,	5,380	1.02	-	-	-	-
Rockport,	135	Feb. 23, 1895,	5,736	1.08	-	-	-	-
Rowley,	242	Apr. 23, 1896,	19,280	3.65	-	-	-	-
Salem,	474	June 18, 1899,	700	.13	-	-	700	.13
Salisbury,[13]	243	Apr. 27, 1896,	10,560	2.00	-	-	-	-
Salisbury,[14]	405	Feb. 11, 1898,	11,500	2.18	-	-	-	-
Salisbury,[13]	540	Apr. 25, 1901,	13,728	2.60	-	-	-	-
Saugus,	34	July 11, 1894,	8,811	1.67	8,444	1.60	-	-
Swampscott,	375	Oct. 14, 1897,	8,780	1.66	7,576	1.43	294	.06
Topsfield,[15]	383	Nov. 27, 1897,	26,031	4.93	-	-	-	-
Topsfield,[16]	491	Apr. 11, 1900,	11,100	2.10	-	-	-	-
Topsfield,[17]	497	June 4, 1900,	7,920	1.50	-	-	-	-
Wenham,[18]	64	- -	9,100	1.72	3,194	.61	2,700	.51
West Newbury,[8]	101	Nov. 26, 1894,	27,017	5.11	11,731	2.22	-	-
West Newbury,[19]	206	July 25, 1895,	4,000	.76	-	-	-	-
Totals,	.	. . .	814,106	154.19	134,741	25.52	17,902	3.39

Fifty-seven petitions (two county, sixteen city and thirty-nine town), in seven cities and twenty-four towns.

Average distance petitioned for, 14,283 feet (2.71 miles).

Forty-five lay-outs, in seven cities and twelve towns.

Laid out on county petitions, 24,114 feet (4.57 miles).

Laid out on city petitions, 40,204 feet (7.61 miles).

Laid out on town petitions, 88,325 feet (16.73 miles).

Total length laid out, 152,643 feet (28.91 miles); average, 3,392 feet (.64 mile).

Percentage of length laid out to length petitioned for, 18.75.

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[1] Haverhill-Lawrence road.

[2] Lowell road.

[3] Woodland Street.

[4] Main Street.

[5] Maple Street.

[6] Newburyport road, *via* Oldtown.

[7] Newburyport road, *via* turnpike.

[8] Haverhill-Newburyport road.

[9] Lawrence Street.

[10] Salem Street.

[11] From Lynn line, Washington and Lynn streets.

[12] From Danvers line, Sylvan and Danvers streets.

[13] Newburyport-New Hampshire road.

[14] Haverhill road.

[15] Salem, Boston, Main and Haverhill streets.

[16] Central and Wenham streets.

[17] Grove, Washington and Boxford streets.

[18] On county petition.

[19] Proposed relocation.

Franklin County.

County, City or Town.	No.	Petition received.	Length petitioned for.		Length laid out.			
					1894-1900.		1901.	
			Feet.	Miles.	Feet.	Miles.	Feet	Miles.
Ashfield,[1]	195	June 26, 1895,	5,300	1.00	-	-	-	-
Ashfield,[2]	367	Sept. 18, 1897,	8,900	1.70	8,492	1.61	-	-
Ashfield,[1]	454	Jan. 10, 1899,	5,200	.99	-	-	-	-
Ashfield,[1]	464	May 1, 1899,	5,280	1.00	-	-	-	-
Buckland,[3]	38	July 14, 1894,	1,170	.22	796	.15	-	-
Buckland,[4]	112	Jan. 5, 1895,	5,280	1.00	5,308	1.01	-	-
Buckland,[4]	224	Dec. 28, 1895,	5,280	1.00	5,325	1.01	-	-
Buckland,[4]	315	Feb. 15, 1896,	5,280	1.00	5,274	1.00	-	-
Buckland,[4]	458	Mar. 9, 1899,	17,160	3.25	1,744	.33	-	-
Charlemont,[5]	120	Jan. 18, 1895,	7,500	1.42	3,366	.64	-	-
Charlemont,[1]	450	Dec. 24, 1898,	34,320	6.50	693	.13	-	-
Colrain,[1],[3]	43	July 17, 1894,	-	-	-	-	-	-
Colrain,[1]	133	Feb. 20, 1895,	12,438	2.36	5,679	1.08	3,985	.75
Colrain,[1]	432	Aug. 2, 1898,	13,500	2.56	-	-	-	-
Conway,	215	Sept. 4, 1895,	14,147	2.68	-	-	-	-
Deerfield,[6],[7]	24	- -	9,400	1.79	8,093	1.53	-	-
Deerfield,[8]	329	Mar. 10, 1897,	37,288	7.06	2,300	.44	1,979	.37
Erving,	152	Mar. 29, 1895,	10,717	2.03	10,791	2.04	-	-
Franklin County,[9]	24	July 9, 1894,	-	-	-	-	-	-
Gill,	130	Feb. 7, 1895,	10,520	1.99	-	-	-	-
Greenfield,[10]	188	June 10, 1895,	23,700	4.49	-	-	-	-
Greenfield,[11]	332	Mar. 23, 1897,	6,722	1.27	3,100	.59	-	-
Greenfield,[11]	397	Dec. 23, 1897,	5,300	1.00	-	-	-	-
Greenfield,[12]	456	Feb. 2, 1899,	4,680	.89	-	-	-	-
Greenfield,[13]	457	Feb. 2, 1899,	8,550	1.62	2,116	.40	-	-
Montague,[14]	304	Dec. 18, 1896,	10,560	2.00	-	-	-	-
Montague,[15]	359	July 11, 1897,	6,587	1.25	5,761	1.09	-	-
Montague,[16]	360	July 11, 1897,	8,305	1.57	-	-	-	-
Montague,[17]	453	Jan. 3, 1899,	4,000	.76	2,855	.54	-	-
Montague,[18]	498	June 5, 1900,	16,050	3.04	-	-	-	-
Montague,[18]	553	June 25, 1901,	5,280	1.00	-	-	-	-
New Salem,	258	June 8, 1896,	27,329	5.18	-	-	-	-
Northfield,[19]	422	June 8, 1898,	-	-	-	-	-	-
Northfield,[18]	489	Apr. 2, 1900,	38,280	7.25	-	-	3,300	.63
Orange,[3]	6	July 2, 1894,	30,559	5.74	13,739	2.60	2,144	.41
Orange,[3],[20]	103	Dec. 10, 1894,	-	-	-	-	-	-
Orange,[3],[20]	301	Nov. 27, 1896,	-	-	-	-	-	-
Shelburne,[21]	35	July 11, 1894,	12,138	2.30	11,398	2.16	-	-
Shelburne,[22]	227	Jan. 13, 1896,	5,280	1.00	-	-	-	-
Sunderland,[3]	52	July 24, 1894,	4,151	.80	992	.19	-	-
Sunderland,[23]	402	Jan. 11, 1898,	5,280	1.00	-	-	-	-
Sunderland,[24]	541	Apr. 26, 1901,	11,880	2.25	-	-	-	-
Whately,[8],[25]	325	Feb. 28, 1897,	5,400	1.03	-	-	-	-
Whately,[5],[26]	408	Feb. 11, 1898,	5,300	1.00	4,122	.78	801	.15
Whately,[8]	530	Mar. 2, 1901,	13,042	2.47	-	-	1,799	.34
Totals,	.	. . .	467,053	88.46	101,944	19.31	14,008	2.65

Forty-four petitions (one county and forty-three town), in sixteen towns.
Average distance petitioned for, 10,615 feet (2.01 miles).
Forty-three lay-outs, in thirteen towns.
Laid out on county petitions, 47,953 feet (9.08 miles).
Laid out on town petitions, 67,999 feet (12.88 miles).
Total length laid out, 115,952 feet (21.96 miles); average, 2,697 feet (.51 mile).
Percentage of length laid out to length petitioned for, 24.83.

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[1] Shelburne Falls road.
[2] Relocation.
[3] Duplicate of county petition.
[4] Ashfield road.
[5] In part mine road to Rowe.
[6] On county petition.
[7] Sunderland road.
[8] Greenfield-Northampton road.
[9] See Buckland, Colrain, Deerfield, Erving, Orange, Shelburne and Sunderland.
[10] Bernardston road.
[11] Deerfield road.
[12] Turner's Falls road.
[13] Montague City road.
[14] Miller's Falls, *via* ferry road.
[15] Miller's Falls, *via* pipe line.
[16] Miller's Falls, *via* L Street.
[17] Third and Prospect streets.
[18] Miller's Falls road.
[19] Covered by subsequent petition.
[20] Covered by previous petition.
[21] Colrain road.
[22] Greenfield road.
[23] Sunderland Street.
[24] Amherst road.
[25] From Hatfield line.
[26] From Deerfield line.

Hampden County.

COUNTY, CITY OR TOWN.	No.	Petition received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
					1894-1900.		1901.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Agawam,	488	Apr. 2, 1900,	15,509	2.94	-	-	-	-
Blandford,[1]	216	Sept. 7, 1895,	13,377	2.54	-	-	-	-
Blandford,[2]	321	Feb. 23, 1897,	13,858	2.63	-	-	-	-
Brimfield,[3]	40	July 6, 1894,	61,615	11.67	12,345	2.34	6,309	1.19
Brimfield,[4],[5]	131	- -	9,355	1.77	-	-	-	-
Chester,[6],[7]	104	Dec. 11, 1894,	-	-	-	-	-	-
Chester,[6],[7]	426	June 23, 1898,	-	-	-	-	-	-
Chester,[6]	441	Dec. 16, 1898,	34,950	6.62	3,472	.66	2,578	.49
Chicopee,	223	Dec. 28, 1895,	5,700	1.08	4,847	.92	-	-
East Longmeadow,	202	July 11, 1895,	25,426	4.82	-	-	-	-
Granville,	87	Sept. 6, 1894,	12,848	2.44	-	-	-	-
Hampden,	201	July 11, 1895,	18,081	3.42	-	-	-	-
Hampden County,[8]	19	July 6, 1894,	-	-	-	-	-	-
Hampden County,[9]	131	Feb. 12, 1895,	-	-	-	-	-	-
Hampden County,[10]	241	Apr. 23, 1896,	-	-	-	-	-	-
Hampden County,[11]	273	July 3, 1896,	-	-	-	-	-	-
Holyoke,[4]	273	- -	5,300	1.00	-	-	-	-
Longmeadow,	333	Mar. 24, 1897,	5,400	1.02	-	-	-	-
Ludlow,	236	Mar. 11, 1896,	14,813	2.80	-	-	-	-
Monson,[12]	57	July 26, 1894,	14,960	2.83	4,933	.93	-	-
Monson,[4],[5]	131	- -	6,925	1.31	-	-	-	-
Monson,[13]	502	Oct. 1, 1900,	1,760	.33	-	-	529	.10
Palmer,[4]	131	- -	46,034	8.72	8,350	1.58	4,241	.80
Palmer,[13]	506	Nov. 27, 1900,	675	.13	-	-	675	.13
Palmer,[14]	556	Oct. 21, 1901,	1,000	.19	-	-	-	-
Russell,[4]	19	- -	35,380	6.70	35,189	6.66	-	-
Southwick,	545	May 2, 1901,	14,520	2.75	-	-	-	-
Wales,	41	July 16, 1894,	35,922	6.80	-	-	5,493	1.04
Westfield,[4]	19	- -	40,900	7.75	21,598	4.09	4,334	.82
West Springfield,[15]	113	Jan. 8, 1895,	24,200	4.58	8,054	1.53	-	-
West Springfield,[4]	241	- -	5,708	1.08	-	-	-	-
Wilbraham,[4]	131	- -	27,750	5.26	5,998	1.14	4,614	.88
Wilbraham,[16]	247	May 8, 1896,	4,117	.77	4,140	.78	-	-
Totals,	.	. . .	496,033	93.95	108,921	20.63	28,773	5.45

Twenty-five petitions (four county, one city and twenty town), in two cities and seventeen towns.
Average distance petitioned for, 19,841 feet (3.76 miles).
Forty-five lay-outs, in one city and nine towns.
Laid out on county petitions, 91,397 feet (17.31 miles).
Laid out on city petitions, 4,847 feet (.92 mile).
Laid out on town petitions, 41,450 feet (7 85 miles).
Total length laid out, 137,694 feet (26.08 miles); average, 3,060 feet (.58 mile).
Percentage of length laid out to length petitioned for, 27.76.

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[1] Huntington road.
[2] Russell road.
[3] Road to Brimfield Centre and Wales.
[4] On county petition.
[5] River road.
[6] Springfield-Pittsfield road.
[7] Covered by subsequent petition.
[8] See Russell, Westfield and West Springfield.
[9] See Wilbraham, Monson, Palmer and Brimfield.
[10] See West Springfield, Agawam road.
[11] See Holyoke.
[12] Palmer road.
[13] Brimfield road.
[14] Commercial Street.
[15] Duplicate of county petition.
[16] Relocation.

Hampshire County.

COUNTY, CITY OR TOWN.	No.	Petition received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
					1894-1900.		1901.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Amherst,[1]	181	May 18, 1895,	5,356	1.02	-	-	5,035	.95
Amherst,[2]	550	June 10, 1901,	18,480	3.50	-	-	-	-
Belchertown,[3]	220	Nov. 18, 1895,	5,280	1.00	3 509	.66	1,050	.20
Belchertown,[3]	282	Aug. 6, 1896,	5,280	1.00	-	-	2,141	.41
Belchertown,[4]	461	Mar. 16, 1899,	2,640	.50	-	-	-	-
Belchertown,[3]	512	Jan. 9, 1901,	4,488	.85	-	-	-	-
Belchertown,[5]	529	Mar. 12, 1901,	15,840	3.00	-	-	-	-
Chesterfield,[6]	128	Feb. 6, 1895,	3,067	.58	-	-	-	-
Cummington,[6]	27	July 10, 1894,	55,053	10.43	-	-	-	-
Easthampton,[7]	114	Jan. 10, 1895,	5,900	1.12	4,200	.80	1,600	.80
Easthampton,[1],[6]	189	July 10, 1895,	7,500	1.42	6,963	1.32	-	-
Enfield,[8]	283	Aug. 25, 1896,	-	-	-	-	-	-
Enfield,	524	Feb. 12, 1901,	23,760	4.50	-	-	-	-
Goshen,	2	June 28, 1894,	29,480	5.58	10,058	1.91	-	-
Granby,[9],[10]	5	- -	3,347	.63	3,347	.63	-	-
Granby,[9]	289	Sept. 9, 1896,	10,700	2.03	-	-	-	-
Granby,[11]	536	Apr. 2, 1901,	17,160	3.25	-	-	-	-
Greenwich,	295	Oct. 17, 1896,	5,464	1.04	-	-	-	-
Hadley,[1],[6]	94	Oct. 20, 1894,	5,673	1.08	5,676	1.08	-	-
Hadley,[1]	200	July 11, 1895,	4,133	.78	4,133	.78	-	-
Hadley,[1]	286	Aug. 27, 1896,	14,749	2.79	5,651	1.07	-	-
Hampshire County,[12]	5	June 29, 1894,	-	-	-	-	-	-
Hatfield,[13]	165	Apr. 23, 1895,	5,280	1.00	-	-	-	-
Hatfield,[14]	164	Apr. 23, 1895,	2,500	.47	-	-	2,050	.39
Huntington,	99	Nov. 24, 1894,	14,408	2.73	5,336	1.01	-	-
Middlefield,	177	May 14, 1895,	5,400	1.03	-	-	-	-
Northampton,[6],[15]	97	July 31, 1894,	2,997	.56	2,997	.56	-	-
Northampton,[6],[16]	194	June 25, 1895,	9,235	1.75	5,892	1.12	-	-
Northampton,[17]	470	May 27, 1899,	4,500	.85	-	-	-	-
South Hadley,[9],[10]	5	- -	15,571	2.95	12,775	2.42	-	-
South Hadley,[6],[9]	288	Sept. 3, 1896,	-	-	-	-	-	-
South Hadley,[18]	517	Jan. 22, 1901,	9,240	1.75	-	-	-	-
Southampton,	253	May 25, 1896,	5,280	1.00	-	-	-	-
Ware,[19]	205	July 29, 1895,	4,100	.78	4,100	.78	-	-
Ware,[19]	455	Feb. 2, 1899,	10,300	1.95	5,400	1.02	-	-
Ware,[20]	519	Feb. 5, 1901,	15,048	2.85	-	-	-	-
Ware,[5]	525	Feb. 12, 1901,	26,400	5.00	-	-	-	-
Williamsburg,[10]	5	- -	31,748	6.01	3,100	.58	2,040	.39
Williamsburg,[6],[21]	129	Feb. 6, 1895,	-	-	-	-	-	-
Williamsburg,[6],[22]	249	May 11, 1896,	-	-	-	-	-	-
Williamsburg,[23]	411	Mar. 17, 1898,	6,036	1.14	6,036	1.14	-	-
Williamsburg,[6],[22]	439	Dec. 12, 1898,	-	-	-	-	-	-
Totals,	.	. . .	411,388	77.91	89,173	16.89	13,916	2.64

Thirty-nine petitions (one county, three city and thirty-five town), in one city and seventeen towns.

Average distance petitioned for, 10,548 feet (2.00 miles).

Forty lay-outs, in one city and eleven towns.

Laid out on county petitions, 50,808 feet (9.62 miles).

Laid out on city petitions, 2,997 feet (.56 mile).

Laid out on town petitions, 49,284 feet (9.34 miles).

Total length laid out, 103,089 feet (19.53 miles); average, 2,577 feet (.49 mile).

Percentage of length laid out to length petitioned for, 25.07.

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[1] Northampton road.
[2] Sunderland road.
[3] Granby road.
[4] Depot road.
[5] Enfield road.
[6] Duplicate of county petition.
[7] Holyoke Street.
[8] Covered by subsequent petition.
[9] Holyoke road.
[10] On county petition.
[11] Belchertown road.
[12] See Chesterfield, Cummington, Easthampton, Granby, Goshen, Hadley, Northampton, South Hadley and Williamsburg.
[13] Road to Hatfield village.
[14] North Hatfield road.
[15] Bridge Street.
[16] Easthampton road.
[17] Smith's ferry road.
[18] Newton Street.
[19] Gilbertville road.
[20] Palmer road.
[21] Chesterfield road.
[22] Goshen road.
[23] Relocation.

Middlesex County.

County, City or Town.	No.	Petition received.	Length petitioned for.		Length laid out.			
					1894-1900.		1901.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Acton,[1]	119	Jan. 7, 1895,	6,563	1.24	-	-	-	-
Acton,[1]	138	Feb. 28, 1895,	12,129	2.30	-	-	-	-
Acton,[2],[3]	233	- -	21,922	4.15	-	-	3,800	.72
Acton,[3],[4]	413	- -	24,500	4.64	14,700	2.78	3,407	.64
Ashby,	1	June 27, 1894,	18,625	3.53	18,826	3.57	-	-
Ashland,[5]	361	July 24, 1897,	11,843	2.24	-	-	-	-
Ashland,[6]	362	July 24, 1897,	9,112	1.73	-	-	-	-
Ashland,[7]	500	June 21, 1900,	6,600	1.25	-	-	-	-
Ayer,	225	Jan. 1, 1896,	14,246	2.70	-	-	-	-
Bedford,	175	May 14, 1895,	19,635	3.72	2,872	.54	-	-
Belmont,	343	May 21, 1897,	5,109	.97	-	-	-	-
Billerica,	264	June 13, 1896,	18,490	3.50	-	-	-	-
Boxborough,[2],[3]	233	- -	17,500	3.31	7,200	1.36	-	-
Burlington,[8]	336	Apr. 16, 1897,	14,205	2.69	-	-	-	-
Burlington,[9]	582	Mar. 13, 1901,	20,592	3.90	-	-	-	-
Carlisle,	109	Dec. 26, 1894,	26,381	4.99	-	-	-	-
Chelmsford,[10],[11]	50	July 20, 1894,	5,583	1.06	-	-	-	-
Chelmsford,[3],[11]	266	- -	6,100	1.16	4,908	.93	1,186	.23
Chelmsford,[12]	467	May 24, 1899,	6,600	1.25	-	-	-	-
Chelmsford,[13]	468	May 24, 1899,	9,240	1.75	-	-	-	-
Chelmsford,[14]	518	Jan. 31, 1901,	6,600	1.25	-	-	1,500	.28
Chelmsford,[15]	539	Apr. 22, 1901,	9,240	1.75	-	-	-	-
Concord,[16]	81	Sept. 11, 1894,	10,393	1.97	7,719	1.46	-	-
Concord,[4],[10]	388	Dec. 7, 1897,	3,800	.72	2,786	.53	-	-
Concord,[17]	487	Mar. 28, 1900,	8,282	1.57	-	-	-	-
Dracut,[18]	344	June 3, 1897,	21,378	4.05	-	-	-	-
Dracut,[19]	473	June 6, 1899,	17,234	3.26	-	-	-	-
Dunstable,	291	Sept. 17, 1896,	8,778	1.66	-	-	-	-
Framingham,[20]	303	Dec. 17, 1896,	8,296	1.57	-	-	-	-
Framingham,[21]	492	Apr. 20, 1900,	17,420	3.30	-	-	-	-
Groton,[22]	105	Dec. 17, 1894,	40,215	7.62	-	-	-	-
Groton,[4],[10]	219	Nov. 14, 1895,	22,597	4.28	-	-	-	-
Groton,[4],[23]	551	June 10, 1901,	6,600	1.25	-	-	2,846	.54
Holliston,	363	July 30, 1897,	33,480	6.34	-	-	-	-
Hopkinton,	309	Jan. 6, 1897,	20,440	3.87	-	-	-	-
Hudson,	370	Sept. 25, 1897,	31,057	5.88	-	-	-	-
Lexington,[16]	79	Aug. 8, 1894,	18,300	3.46	18,214	3.45	-	-
Lexington,[24]	419	May 14, 1898,	13,200	2.50	4,462	.85	-	-
Lincoln,[16]	80	Aug. 8, 1894,	10,850	2.06	10,885	2.07	-	-

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[1] Littleton road, *via* North Acton.
[2] Harvard turnpike.
[3] On county petition.
[4] Great road.
[5] Southborough road.
[6] Pond Street.
[7] Framingham road.
[8] Lowell turnpike.
[9] Cambridge and Lowell streets.
[10] Duplicate of county petition.
[11] Truant school road.
[12] Tyngsborough road, west.
[13] Billerica road.
[14] Tyngsborough road, east.
[15] Lowell road from Chelmsford Centre.
[16] Lexington-Concord road.
[17] Elm Street.
[18] North road to Methuen.
[19] River road, new location.
[20] Concord Street.
[21] Ashland-Natick road.
[22] Lowell-Fitchburg road.
[23] From Pepperell line.
[24] Bedford road.

Middlesex County — Continued.

County, City or Town.	No.	Petition received.	Length petitioned for.		Length laid out.			
					1894-1900.		1901.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Lincoln,[1]	377	Aug. 30, 1897,	17,800	3.37	-	-	-	-
Littleton,[2]	218	Nov. 14, 1895,	12,110	2.29	-	-	-	-
Littleton,[3],[4]	412	- -	10,200	1.93	-	-	-	-
Littleton,[3],[5]	413	- -	27,800	5.27	-	-	-	-
Lowell,[3],[6]	44	- -	5,230	.99	5,115	.97	-	-
Lowell,[7],[8]	55	July 25, 1894,	7,062	1.34	7,045	1.34	-	-
Lowell,[9]	409	Mar. 9, 1898,	5,800	1.10	-	-	-	-
Marlborough,[10]	143	Mar. 15, 1895,	12,868	2.44	9,000	1.70	3,700	.70
Marlborough,[11]	271	June 26, 1896,	17,835	3.38	2,142	.41	-	-
Maynard,	366	Sept. 9, 1897,	11,164	2.11	-	-	-	-
Medford,[12],[7]	265	June 13, 1896,	4,918	.93	-	-	-	-
Medford,[12]	446	Dec. 19, 1898,	4,200	.80	-	-	-	-
Melrose,	485	Mar. 8, 1900,	5,966	1.13	-	-	-	-
Middlesex County,[13]	44	July 17, 1894,	-	-	-	-	-	-
Middlesex County,[8],[14]	45	July 17, 1894,	-	-	-	-	-	-
Middlesex County,[15],[16]	238	Feb. 25, 1896,	-	-	-	-	-	-
Middlesex County,[8],[14]	266	June 15, 1896,	-	-	-	-	-	-
Middlesex County,[12]	274	July 13, 1896,	-	-	-	-	-	-
Middlesex County,[2]	412	Feb. 3, 1898,	-	-	-	-	-	-
Middlesex County,[5],[17]	413	Feb. 3, 1898,	-	-	-	-	-	-
Middlesex County,[18]	427	June 25, 1898,	-	-	-	-	-	-
Middlesex County,[19]	494	May 8, 1900,	-	-	-	-	-	-
Middlesex County,[20]	503	Oct. 19, 1900,	-	-	-	-	-	-
Middlesex County,[21]	558	Nov. 11, 1901,	-	-	-	-	-	-
Natick,[22]	251	May 21, 1896,	6,813	1.29	-	-	-	-
Natick,[23]	493	May 8, 1900,	17,160	3.25	-	-	5,995	1.14
Newton,[24]	337	Apr. 26, 1897,	780	.15	-	-	-	-
Newton,[25]	477	Nov. 1, 1899,	5,500	1.04	-	-	5,449	1.03
North Reading,	107	Dec. 24, 1894,	31,060	5.88	5,329	1.01	3,971	.75
Pepperell,	299	Nov. 11, 1896,	18,700	3.54	-	-	-	-
Reading,	157	Apr. 10, 1895,	23,100	4.38	5,650	1.07	-	-
Sherborn,	250	May 14, 1896,	5,500	1.04	-	-	-	-
Shirley,	416	Apr. 21, 1898,	7,400	1.40	-	-	-	-
Stoneham,[7],[12]	280	July 30, 1896,	3,086	.59	3,006	.57	-	-
Stoneham,[26]	355	July 7, 1897,	6,448	1.22	3,300	.62	2,050	.39
Stow,	378	Nov. 1, 1897,	24,215	4.59	-	-	-	-
Sudbury,[27]	214	Aug. 24, 1895,	5,300	1.00	-	-	-	-
Sudbury,[27]	230	Feb. 16, 1896,	20,400	3.86	7,953	1.50	11,748	2.22

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[1] South Great road.
[2] Littleton Depot to Great road.
[3] On county petition.
[4] Ayer road.
[5] Great road.
[6] Tyngsborough road, boulevard.
[7] Duplicate of county petition.
[8] Truant school road.
[9] First Street to Dracut.
[10] Northborough road.
[11] Sudbury road.
[12] Medford-Stoneham road.
[13] See Lowell and Tyngsborough.
[14] See Lowell and Chelmsford.
[15] Harvard turnpike.
[16] See Boxborough and Acton.
[17] See Concord, Acton, Littleton and Groton.
[18] See Tewksbury.
[19] See Natick.
[20] See Westford.
[21] See Hopkinton.
[22] Sherborn road.
[23] Central Street.
[24] At Weston bridge.
[25] Winchester and Needham streets.
[26] From Reading line.
[27] Boston-Worcester road.

Middlesex County — Concluded.

County, City or Town.	No.	Petition received.	Length petitioned for		Length laid out.			
					1894-1900.		1901.	
			Feet.	Miles	Feet.	Miles.	Feet.	Miles.
Tewksbury,[1]	257	June 5, 1896,	14,700	2.78	3,000	.57	2,900	.55
Tewksbury,[1]	357	July 8, 1897,	20,188	3.82	-	-	-	-
Tewksbury,[2],[3]	427	- -	11,088	2.10	-	-	-	-
Townsend,[4]	149	Mar. 21, 1895,	16,830	3.19	13,769	2.60	1,888	.36
Townsend,[4]	466	May 24, 1899,	17,800	3.37	-	-	-	-
Tyngsborough,[2],[5]	44	- -	15,552	2.94	15,588	2.95	-	-
Tyngsborough,[6]	444	Dec. 18, 1898,	21,120	4.00	-	-	-	-
Wakefield,[7]	400	Dec. 29, 1897,	17,979	3.41	-	-	-	-
Wakefield,[8]	469	May 15, 1899,	8,580	1.62	-	-	-	-
Watertown,	151	Mar. 27, 1895,	17,695	3.35	4,472	.85	-	-
Wayland,[9]	212	Aug. 10, 1895,	15,450	2.93	12,005	2.28	-	-
Wayland,[10]	334	Mar. 31, 1897,	11,620	2.20	-	-	-	-
Westford,[11]	115	Jan. 15, 1895,	21,900	4.15	-	-	-	-
Westford,[2],[12]	503	- -	15,840	3.00	-	-	-	-
Weston,[9]	322	Feb. 24, 1897,	17,508	3.32	16,644	3.15	-	-
Weston,[10]	323	Feb. 24, 1897,	21,269	4.03	-	-	-	-
Wilmington,[13]	345	June 10, 1897,	37,682	7.14	-	-	-	-
Wilmington,[1]	349	July 22, 1897,	9,918	1.88	-	-	-	-
Winchester,	244	Apr. 28, 1896,	10,310	1.95	10,306	1.95	-	-
Woburn,[14]	448	Dec. 21, 1898,	9,925	1.88	4,900	.93	3,970	.75
Woburn,[15]	449	Dec. 21, 1898,	19,800	3.75	-	-	-	-
Totals,	.	. . .	1,254,304	237.56	221,796	42.01	54,410	10.30

Eighty-eight petitions (eleven county, eleven city and sixty-six town), in six cities and forty-two towns.

Average distance petitioned for, 14,254 feet (2.70 miles).

Eighty-one lay-outs, in four cities and twenty-one towns.

Laid out on county petitions, 74,550 feet (14.12 miles).

Laid out on city petitions, 41,321 feet (7.82 miles).

Laid out on town petitions, 160,335 feet (30.37 miles).

Total length laid out, 276,206 feet (52.31 miles); average, 3,410 feet (.65 mile).

Percentage of length laid out to length petitioned for, 22.02.

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[1] Boston-Lowell road.

[2] On county petition.

[3] Lowell-Lawrence road.

[4] Ashby-Pepperell road.

[5] Lowell Road, north of river.

[6] Lowell Road, south of river.

[7] Railroad and Nahant streets.

[8] Main and Lowell streets.

[9] Boston-Worcester road.

[10] Boston-Framingham road.

[11] Carlisle road.

[12] Great road to Lowell.

[13] Boston-Lawrence road.

[14] Cambridge Street.

[15] Main, School, Plain, Washington and Salem streets and Mishawum road.

Nantucket County.

County, City or Town.	No.	Petition received.	Length petitioned for.		Length laid out.			
					1894-1900.		1901.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Nantucket,	11	July 3, 1894,	34,185	6.47	27,290	5.17	3,770	.71

Eleven lay-outs.

Length laid out, 31,060 feet (5.88 miles).

Percentage of length laid out to length petitioned for, 91.50.

Norfolk County.

County, City or Town.	No.	Petition received.	Length petitioned for.		Length laid out.			
					1894-1900.		1901.	
			Feet.	Miles.	Feet.	Miles	Feet.	Miles.
Bellingham,[1] . . .	173	May 13, 1895,	3,900	.74	-	-	-	-
Bellingham,[1] . . .	424	June 22, 1898,	46,700	8.84	-	-	-	-
Braintree, ...	116	Jan. 10, 1895,	6,700	1.27	2,431	.46	-	-
Cohasset, ...	158	Apr. 2, 1895,	11,300	2.14	9,151	1.73	-	-
Dedham, ...	307	Dec. 31, 1896,	3,900	.74	-	-	-	-
Foxborough,[2] . . .	123	Jan. 29, 1895,	23,875	4.52	-	-	5,158	.97
Foxborough,[3] . . .	163	Apr. 24, 1895,	5,840	1.11	-	-	-	-
Franklin, ...	298	Nov. 6, 1896,	9,227	1.75	-	-	-	-
Holbrook, . . .	9	July 10, 1894,	11,848	2.24	5,817	1.11	-	-
Medway,[4]	311	Jan. 18, 1897,	5,535	1.05	-	-	-	-
Medway,[5]	368	Sept. 2, 1897,	9,292	1.76	-	-	-	-
Millis,[6]	381	Nov. 12, 1897,	6,265	1.19	-	-	-	-
Milton, ...	190	June 15, 1895,	5,780	1.09	4,600	.87	-	-
Needham,[6] . . .	154	Apr. 2, 1895,	9,050	1.71	-	-	-	-
Needham,[7] . . .	478	Nov. 1, 1899,	5,900	1.12	-	-	5,252	.99
Norfolk,[8]	88	Sept. 21, 1894,	7,676	1.45	7,676	1.45	-	-
Norfolk,[9]	356	July 8, 1897,	21,467	4.07	-	-	-	-
Norwood, ...	51	July 21, 1894,	18,747	3.55	10,822	2.05	-	-
Quincy,[10]	237	Mar. 18, 1896,	9,900	1.87	2,607	.49	-	-
Quincy,[11]	292	Sept. 17, 1896,	6,515	1.23	-	-	-	-
Quincy,[12]	513	Jan. 11, 1901,	3,000	.57	-	-	-	-
Randolph, . . .	208	Aug. 3, 1895,	9,050	1.71	-	-	-	-
Sharon, ...	159	Apr. 12, 1895,	28,718	5.44	-	-	-	-
Stoughton, . . .	228	Jan. 15, 1896,	20,538	3.89	-	-	-	-
Walpole, ...	77	Aug. 4, 1894,	30,300	5.74	23,963	4.54	-	-
Wellesley,[13] . . .	425	June 22, 1898,	21,120	4.00	-	-	-	-
Wellesley,[14] . . .	495	May 8, 1900,	6,340	1.20	-	-	6,209	1.18
Westwood, . . .	354	July 2, 1897,	5,610	1.06	5,530	1.05	-	-
Weymouth,[15] . . .	59	July 27, 1894,	9,400	1.78	9,237	1.75	-	-
Weymouth,[16] . . .	63	July 30, 1894,	1,330	.25	1,330	.25	-	-
Weymouth,[17] . . .	414	Mar. 28, 1898,	28,090	5.32	-	-	-	-
Wrentham, . . .	32	July 10, 1894,	38,150	7.23	24,830	4.70	4,000	.76
Wrentham,[18] . . .	496	May 24, 1900,	-	-	-	-	-	-
Totals, . . .	.	. . . .	431,008	81.63	107,994	20.45	20,619	3.91

Thirty-three petitions (three city and thirty town), in one city and twenty-one towns.
Average distance petitioned for, 13,061 feet (2.47 miles).
Forty-five lay-outs, in one city and twelve towns.
Laid out on city petitions, 2,607 feet (.49 mile).
Laid out on town petitions, 126,006 feet (23.86 miles).
Total length laid out, 128,613 feet (24.36 miles).
Percentage of length laid out to distance petitioned for, 29.84.

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[1] Woonsocket road.
[2] Mansfield-Norfolk road.
[3] Bird, Baker and Chestnut streets.
[4] Village Street.
[5] Village, Main and Oakland streets.
[6] Great Plain Avenue.
[7] Highland Avenue.
[8] Providence turnpike.
[9] Walpole-Franklin road.
[10] Washington Street.
[11] Randolph Street.
[12] Quincy Avenue.
[13] Worcester turnpike.
[14] Central Street to Natick line.
[15] Bridge Street, Hingham road.
[16] Ann Street.
[17] Washington and Main streets.
[18] For widening a portion of road previously petitioned for.

Plymouth County.

County, City or Town.	No.	Petition received.	Length petitioned for.		Length laid out. 1894-1900.		Length laid out. 1901.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Abington,[1]	58	July 27, 1894,	8,660	1.64	-	-	-	-
Abington,[2]	192	Apr. 19, 1895,	10,300	1.95	3,700	.70	2,650	.48
Bridgewater,[3]	217	Nov. 14, 1895,	6,600	1.25	-	-	-	-
Bridgewater,[4]	499	June 14, 1900,	19,270	3.65	-	-	-	-
Brockton,[5]	61	July 27, 1894,	5,525	1.05	-	-	-	-
Brockton,[6]	270	June 22, 1896,	9,860	1.87	9,860	1.87	-	-
Brockton,[7]	482	Feb. 8, 1900,	3,470	.66	3,468	.66	-	-
Brockton,[8]	505	Nov. 22, 1900,	3,770	.71	-	-	-	-
Carver,[9]	326	Mar. 4, 1897,	-	-	-	-	-	-
Carver,	438	Dec. 9, 1898,	28,400	5.38	-	-	-	-
Duxbury,	70	July 31, 1894,	33,000	6.25	10,850	2.05	-	-
East Bridgewater,[9]	240	Apr. 8, 1896,	-	-	-	-	-	-
East Bridgewater,	544	Apr. 27, 1901,	19,800	3.75	-	-	-	-
Halifax,	54	July 24, 1894,	23,463	4.44	-	-	-	-
Hanover,	66	July 30, 1894,	24,157	4.58	-	-	-	-
Hanson,[10]	262	June 12, 1896,	5,280	1.00	-	-	-	-
Hanson,[11]	263	June 12, 1896,	5,280	1.00	-	-	-	-
Hingham,	8	July 3, 1894,	27,666	5.24	14,037	2.66	-	-
Lakeville,[9]	174	May 14, 1895,	-	-	-	-	-	-
Lakeville,[12]	509	Jan. 1, 1901,	19,800	3.75	-	-	-	-
Lakeville,[13]	538	Apr. 10, 1901,	18,480	3.50	-	-	10,449	1.97
Marion,	29	July 10, 1894,	27,248	5.16	15,080	2.86	2,190	.42
Marshfield,	71	July 31, 1894,	40,400	7.65	10,564	2.00	2,096	.40
Mattapoisett,	30	July 10, 1894,	24,992	4.73	10,434	1.97	3,000	.57
Middleborough,[14]	68	July 31, 1894,	44,859	8.50	14,576	2.76	-	-
Middleborough,[15]	428	June 30, 1898,	32,310	6.12	-	-	-	-
Norwell,	246	May 5, 1896,	5,922	1.12	-	-	-	-
Pembroke,	234	Feb. 27, 1896,	5,280	1.00	-	-	-	-
Plymouth,[16]	72	July 31, 1894,	90,420	17.12	7,509	1.42	-	-
Plymouth,[17]	269	June 22, 1896,	5,846	1.11	5,846	1.11	-	-
Plymouth,[17]	374	Oct. 11, 1897,	6,915	1.31	6,987	1.32	-	-
Plymouth,[16]	501	Aug. 27, 1900,	-	-	-	-	-	-
Plympton,	121	Jan. 22, 1895,	5,280	1.00	-	-	-	-
Rochester,	172	May 13, 1895,	22,108	4.19	-	-	-	-
Rockland,	75	Aug. 1, 1894,	6,900	1.31	-	-	-	-
Scituate,	69	July 31, 1894,	28,500	5.40	9,328	1.77	-	-
Wareham,[18]	42	July 16, 1894,	42,000	7.95	3,014	.57	786	.15
Wareham,[19]	406	Feb. 5, 1898,	18,100	3.43	5,529	1.05	4,055	.77
West Bridgewater,	221	Dec. 4, 1895,	17,100	3.24	5,252	1.00	5,135	.97
Whitman,[20]	65	July 30, 1894,	8,900	1.68	8,957	1.69	-	-
Whitman,[21]	542	Apr. 27, 1901,	11,880	2.25	-	-	-	-
Totals,	.	. . . .	717,741	135.94	144,991	27.46	30,261	5.73

Forty-one petitions (four city and thirty-seven town), in one city and twenty-four towns.

Average distance petitioned for, 17,506 feet (3.32 miles).

Fifty-eight lay-outs, in one city and thirteen towns.

Laid out on city petitions, 13,328 feet (2.52 miles).

Laid out on town petitions, 161,924 feet (30.67 miles).

Total length laid out, 175,252 feet (33.19 miles); average, 3,022 feet (.57 mile).

Percentage of length laid out to length petitioned for, 24.42.

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[1] Randolph Street.
[2] Brockton Avenue.
[3] North Main Street.
[4] South Main Street.
[5] Crescent Street to Whitman.
[6] Belmont Street to Easton.
[7] Centre Street to Abington.
[8] Main Street to West Bridgewater.
[9] Covered by subsequent petition.
[10] Main Street.
[11] Whitman Street.
[12] From Freetown line.
[13] From Middleborough line.
[14] From Wareham line.
[15] From Bridgewater line.
[16] South Shore road.
[17] Pine Hills road.
[18] Fall River-Cape Cod road.
[19] "Onset" road.
[20] Brockton road.
[21] Bedford Street.

Suffolk County.

County, City or Town.	No.	Petition received.	Length petitioned for.		Length laid out.			
					1894-1900.		1901.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Chelsea,	56	July 25, 1894,	5,800	1.10	-	-	3,053	.58
Revere,[1]	60	July 27, 1894,	11,500	2.18	3,535	.67	-	-
Revere,[2]	346	June 10, 1897,	6,506	1.23	-	-	-	-
Revere,[3]	350	June 24, 1897,	3,469	.66	3,045	.58	-	-
Revere,[4]	407	Feb. 7, 1898,	11,000	2.09	-	-	-	-
Winthrop,[5]	73	July 31, 1894,	18,100	3.42	-	-	-	-
Winthrop,[6]	451	Dec. 29, 1898,	-	-	-	-	-	-
Totals,			56,375	10.68	6,580	1.25	3,053	.58

Seven petitions (one city and six town), in one city and two towns.
Average distance petitioned for, 8,054 feet (1.53 miles).
Five lay-outs, in one city and one town.
Total length laid out, 9,633 feet (1.83 miles).
Percentage of length laid out to distance petitioned for, 17.32.

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[1] Salem turnpike.
[2] Ocean Avenue.
[3] Atlantic Avenue.
[4] Ocean Avenue extension.
[5] Revere Street and Crest Avenue.
[6] Covered by previous petition.

Worcester County.

County, City or Town.	No.	Petition received.	Length petitioned for.		Length laid out.			
					1894-1900.		1901.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Ashburnham,	463	Apr. 17, 1899,	13,200	2.50	-	-	-	-
Athol,	37	July 12, 1894,	16,800	3.18	8,475	1.61	-	-
Auburn,	148	Mar. 30, 1895,	28,095	5.32	14,753	2.80	5,207	.99
Auburn,[1]	433	Aug. 24, 1895,	1,437	.27	1,437	.27	-	-
Barre,	146	Mar. 10, 1895,	15,286	2.90	8,611	1.63	-	-
Blackstone,[2]	140	Mar. 2, 1895,	7,700	1.46	-	-	-	-
Blackstone,[3]	399	Dec. 29, 1897,	12,304	2.33	6,156	1.17	-	-
Bolton,[4]	185	June 3, 1895,	5,300	1.00	-	-	-	-
Bolton,[5]	472	June 5, 1899,	32,500	6.16	-	-	-	-
Boylston,	398	Dec. 23, 1897,	10,560	2.00	-	-	-	-
Brookfield,[6]	111	Jan. 2, 1895,	5,972	1.13	-	-	-	-
Brookfield,[6]	300	Nov. 27, 1896,	22,025	4.17	7,356	1.39	-	-
Charlton,[7]	261	June 11, 1896,	10,900	2.06	-	-	5,800	1.10

---

[1] Relocation.
[2] South Main Street.
[3] North Main Street.
[4] Hudson road.
[5] Stow-Lancaster road.
[6] Springfield-Worcester road.
[7] Charlton Depot to Charlton City.

Worcester County — Continued.

COUNTY, CITY OR TOWN.	No.	Petition received.	LENGTH PETITIONED FOR		LENGTH LAID OUT.			
					1894-1900.		1901.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Charlton,[1]	389	Dec. 13, 1897,	5,280	1.00	-	-	-	-
Dana, ...	294	Sept. 24, 1896,	10,560	2.00	-	-	-	-
Douglas, ...	384	Dec. 1, 1897,	10,567	2.00	-	-	-	-
Dudley, ...	391	Dec. 16, 1897,	15,840	3.00	-	-	-	-
Fitchburg,[2] . . .	17	July 5, 1894,	5,493	1.04	5,133	.97	-	-
Fitchburg,[3] . . .	62	July 20, 1894,	20,800	3.94	3,050	.58	2,600	.49
Fitchburg,[4] . . .	93	Oct. 3, 1894,	10,560	2.00	-	-	-	-
Fitchburg,[5] . . .	339	May 14, 1897,	5,280	1.00	3,196	.61	-	-
Gardner, ...	13	July 3, 1894,	29,656	5.62	15,820	3.00	1,900	.36
Grafton, ...	213	Aug. 15, 1895,	16,971	3.21	8,204	1.56	-	-
Hardwick, . . .	207	July 31, 1895,	5,357	1.01	2,052	.39	2,271	.43
Harvard, ...	260	June 11, 1896,	25,700	4.87	3,709	.70	-	-
Holden,[6]	10	July 3, 1894,	27,920	5.29	19,860	3.76	-	-
Holden,[6]	437	Nov. 2, 1898,	9,240	1.75	-	-	-	-
Hopedale,[7] . . .	144	Mar. 16, 1895,	6,040	1.14	-	-	-	-
Hopedale,[8] . . .	423	June 20, 1898,	1,760	.33	-	-	-	-
Hubbardston, . . .	232	Feb. 24, 1896,	10,560	2.00	-	-	-	-
Lancaster,[9] . . .	137	Feb. 28, 1895,	24,808	4.70	-	-	-	-
Lancaster,[10] . . .	554	July 11, 1901,	7,920	1.50	-	-	-	-
Leicester, ...	25	July 9, 1894,	28,110	5.32	25,680	4.87	-	-
Leominster,[9] . . .	91	Sept. 29, 1894,	26,400	5.00	-	-	-	-
Leominster,[11] . . .	543	Apr. 29, 1901,	14,520	2.75	-	-	7,000	1.33
Lunenburg, . . .	16	July 5, 1894,	30,772	5.83	7,650	1.45	2,118	.40
Mendon, ...	84	Aug. 20, 1894,	18,432	3.49	-	-	-	-
Millbury,[12] . . .	372	Oct. 2, 1897,	19,260	3.65	2,000	.38	-	-
Millbury,[13] . . .	484	Feb. 26, 1900,	4,224	.80	-	-	-	-
Millbury,[14] . . .	552	June 13, 1901,	7,565	1.43	-	-	-	-
Milford,[7]	420	June 6, 1898,	9,290	1.76	-	-	-	-
Milford,[8]	421	June 6, 1898,	5,550	1.05	-	-	-	-
New Braintree, . .	210	Aug. 6, 1895,	939	.18	920	.17	-	-
Northborough,[15] . .	122	Jan. 24, 1895,	3,840	.73	-	-	-	-
Northborough,[16] . .	153	Apr. 1, 1895,	11,000	2.08	7,199	1.33	-	-

---

[1] From Oxford line.
[2] Westminster road.
[3] Ashby road.
[4] Leominster road.
[5] Lunenburg road.
[6] Worcester-Gardner road.
[7] Milford-Mendon road.
[8] Milford-Upton road.
[9] Fitchburg road.
[10] Lower road.
[11] Central Street.
[12] Grafton-Worcester road.
[13] Canal and Providence streets.
[14] Sutton road.
[15] Westborough Hospital road.
[16] Worcester-Marlborough road.

Worcester County — Continued.

County, City or Town.	No.	Petition received.	Length petitioned for.		Length laid out.			
					1894-1900.		1901.	
			Feet.	Miles.	Feet.	Miles	Feet.	Miles.
Northborough,[1],[2] . .	373	Oct. 4, 1897,	-	-	2,231	.42	-	-
Northborough,[3] . .	465	May 8, 1899,	16,750	3.17	2,203	.42	-	-
North Brookfield, . .	324	Feb. 25, 1897,	11,913	2.26	-	-	-	-
Oakham, ...	199	July 11, 1895,	15,045	2.85	-	-	-	-
Oxford,[4]	108	Dec. 24, 1894,	33,550	6.35	-	-	-	-
Oxford,[4]	404	Jan. 25, 1898,	10,560	2.00	-	-	-	-
Oxford,[5]	533	Mar. 27, 1901,	3,000	.57	-	-	-	-
Paxton, ...	33	July 10, 1894,	28,500	5.40	17,116	3.24	-	-
Petersham, . . .	296	Oct. 22, 1896,	23,744	4.50	-	-	-	-
Phillipston, . . .	14	July 3, 1894,	17,500	3.31	6,301	1.19	-	-
Princeton,[6] . . .	193	June 22, 1895,	14,221	2.69	5,252	.99	-	-
Princeton,[7] . . .	452	Dec. 29, 1898,	5,730	1.09	-	-	-	-
Royalston, . . .	302	Dec. 7, 1896,	23,195	4.39	-	-	-	-
Rutland,[8]	141	Mar. 5, 1895,	24,581	4.66	-	-	-	-
Rutland,[9]	142	Mar. 5, 1895,	24,268	4.60	-	-	-	-
Shrewsbury,[3] . . .	21	July 6, 1894,	11,000	2.08	11,000	2.08	-	-
Shrewsbury,[3] . . .	308	Jan. 6, 1897,	4,092	.78	4,092	.78	-	-
Shrewsbury,[3] . . .	394	Dec. 22, 1897,	2,800	.53	2,800	.53	-	-
Shrewsbury,[3] . . .	429	July 11, 1898,	10,560	2.00	2,675	.51	-	-
Southborough,[10] . .	161	Apr. 18, 1895,	5,300	1.00	-	-	-	-
Southborough,[10] . .	447	Dec. 20, 1898,	5,440	1.03	-	-	-	-
Southborough,[10] . .	548	May 16, 1901,	5,280	1.00	-	-	-	-
Southbridge,[11] . . .	403	Jan. 13, 1898,	9,846	1.87	-	-	-	-
Southbridge,[12] . . .	486	Mar. 22, 1900,	2,640	.50	-	-	-	-
Southbridge,[13] . . .	528	Feb. 26, 1901,	4,300	.81	-	-	-	-
Spencer,[14]	49	July 19, 1894,	23,418	4.44	6,800	1.29	1,650	.31
Spencer,[14],[2] . . .	320	Feb. 19, 1897,	-	-	-	-	-	-
Sterling,[15]	168	May 1, 1895,	5,280	1.00	4,034	.76	-	-
Sterling,[15]	318	Feb. 18, 1897,	5,280	1.00	-	-	-	-
Sterling,[16]	319	Feb. 18, 1897,	12,882	2.44	-	-	-	-
Sterling,[15]	358	July 8, 1897,	500	.09	-	-	-	-

---

[1] Westborough Hospital road.
[2] Covered by previous petition.
[3] Worcester-Marlborough road.
[4] Worcester-Webster road.
[5] Relocation.
[6] Princeton Depot road.
[7] Sterling road.
[8] Worcester-Gardner road.
[9] Worcester-Athol road.
[10] Westborough-Framingham road.
[11] Charlton City road.
[12] West Main Street.
[13] Dudley road.
[14] Springfield-Worcester road.
[15] Fitchburg road.
[16] Lancaster road.

Worcester County — Concluded.

COUNTY, CITY OR TOWN.	No.	Petition received.	LENGTH PETITIONED FOR.		LENGTH LAID OUT.			
					1894-1900.		1901.	
			Feet.	Miles.	Feet.	Miles.	Feet.	Miles.
Sterling,[1]	396	Dec. 23, 1897,	10,091	1.91	2,807	.53	-	-
Sturbridge, ...	169	May 7, 1895,	12,600	2.39	3,094	.59	-	-
Sutton,[2]	85	Aug. 25, 1894,	6,096	1.16	-	-	-	-
Sutton,[3]	385	Dec. 1, 1897,	7,770	1.47	2,599	.49	2.681	.51
Templeton, ...	86	Sept. 1, 1894,	31,600	5.98	3,300	.63	2,000	.38
Upton, ...	305	Dec. 18, 1896,	27,443	5.20	-	-	-	-
Uxbridge,[2] . . .	89	Sept. 28, 1894,	15,759	2.98	6,717	1.28	2,633	.50
Uxbridge,[3] . . .	379	Nov. 2, 1897,	6,140	1.17	-	-	-	-
Warren,[4]	15	July 5, 1894,	28,020	5.31	14,908	2.82	2,515	.47
Warren,[5]	39	July 16, 1894,	18,868	3.57	-	-	-	-
Webster, ...	392	Dec. 16, 1897,	7,700	1.46	-	-	-	-
Westborough,[6] . .	160	Apr. 14, 1895,	1,100	.21	1,100	.21	-	-
Westborough,[7] . .	306	Dec. 30, 1896,	-	-	-	-	-	-
Westborough,[6] . .	371	Sept. 27, 1897,	2,579	.49	2,579	.49	-	-
Westborough,[6] . .	401	Jan. 10, 1898,	6,048	1.15	-	-	-	-
Westborough,[8] . .	475	June 18, 1899,	34,320	6.50	-	-	-	-
Westborough,[9] . .	537	Apr. 4, 1901,	4,488	.85	-	-	-	-
West Boylston,[1] . .	310	Jan. 15, 1897,	6,100	1.16	6,100	1.16	-	-
West Boylston,[1] . .	369	Sept. 22, 1897,	3,900	.74	2,100	.40	-	-
West Brookfield,[10] . .	222	Dec. 5, 1895,	800	.15	800	.15	-	-
West Brookfield,[4] . .	312	Jan. 25, 1897,	13,350	2.53	4,300	.81	3,650	.69
West Brookfield,[4] . .	382	Nov. 12, 1897,	5,280	1.00	-	-	-	-
Westminster, . . .	23	July 9, 1894,	30,597	5.79	15,825	3.00	-	-
Winchendon, . . .	317	Feb. 17, 1897,	8,866	1.68	-	-	-	-
Worcester,[11] . . .	162	Apr. 22, 1895,	7,636	1.44	7,157	1.35	-	-
Worcester,[12] . . .	327	Mar. 4, 1897,	12,155	2.30	3,486	.66	-	-
Worcester,[13] . . .	328	Mar. 4, 1897,	12,645	2.39	2,850	.54	-	-
Totals, . . .	.	. . .	1,295,419	245.34	295,487	55.96	42,020	7.96

One hundred and three petitions (seven city and ninety-six town), in two cities and fifty-four towns.

Average distance petitioned for, 12,577 feet (2.38 miles).

One hundred and twenty-one lay-outs, in two cities and thirty-two towns.

Laid out on city petitions, 27,472 feet (5.20 miles).

Laid out on town petitions, 310,035 feet (58.72 miles).

Total length laid out, 337,507 feet (63.92 miles); average, 2,789 feet (.53 mile).

Percentage of length laid out to length petitioned for, 26.05.

---

[1] Fitchburg road.
[2] Blackstone Valley road.
[3] Mendon road.
[4] Springfield-Worcester road.
[5] Brimfield road.
[6] Westborough Hospital road.
[7] Covered by subsequent petition.
[8] Southborough-Grafton road.
[9] East and West Main streets.
[10] Ware road.
[11] Pleasant Street to Paxton.
[12] Grove Street to Holden.
[13] West Boylston Street.

SUMMARY BY COUNTIES.

COUNTIES.	PETITIONS RECEIVED.				PETITIONS SITUATED IN —			LAY-OUTS MADE IN —			Number of Lay-outs.
	County.	City.	Town.	Total.	Cities.	Towns.	Total.	Cities.	Towns.	Total.	
Barnstable, . . .	-	-	32	32	-	15	15	-	11	11	47
Berkshire, . . .	15	4	35	54	2	23	25	2	11	13	41
Bristol, . . .	1	4	26	31	2	16	18	1	12	13	45
Dukes, . . .	2	-	4	6	-	5	5	-	4	4	15
Essex, ...	2	16	39	57	7	24	31	7	12	19	45
Franklin, . . .	1	-	43	44	-	16	16	-	13	13	43
Hampden, . . .	4	1	20	25	2	17	19	1	9	10	45
Hampshire, . .	1	3	35	39	1	17	18	1	11	12	40
Middlesex, . . .	11	11	66	88	6	42	48	4	21	25	81
Nantucket, . . .	-	-	1	1	-	1	1	-	1	1	11
Norfolk, . . .	-	3	30	33	1	21	22	1	12	13	45
Plymouth, . . .	-	4	37	41	1	24	25	1	13	14	58
Suffolk, . . .	-	1	6	7	1	2	3	1	1	2	5
Worcester, . . .	-	7	96	103	2	54	56	2	32	34	121
Totals, . . .	37	54	470	561	25	277	302	21	163	184	642

SUMMARY BY COUNTIES — *Concluded.*

COUNTIES.	LENGTHS PETITIONED FOR.		LENGTHS LAID OUT.						Percentage.
			1894-1900.		1901.		TOTAL.		
	Feet.	Miles.	Feet.	Miles.	Feet.	Miles.	Feet.	Miles.	
Barnstable, .	592,271	112.17	149,032	28.23	46,100	8.73	195,182	36.96	32.89
Berkshire, . .	534,415	101.22	116,809	22.12	15,828	3.00	132,637	25.12	24.82
Bristol, . .	532,434	100.84	120,092	22.74	32,282	6.11	152,374	28.85	28.62
Dukes, . .	119,723	22.67	43,088	8.16	2,763	.52	45,851	8.68	38.29
Essex, . . .	814,106	154.19	134,741	25.52	17,902	3.39	152,643	28.91	18.75
Franklin, . .	467,053	88.46	101,944	19.31	14,008	2.65	115,952	21.96	24.83
Hampden, . .	496,033	93.95	108,921	20.63	28,773	5.45	137,694	26.08	27.76
Hampshire, .	411,388	77.91	89,173	16.89	13,916	2.64	103,089	19.53	25.07
Middlesex, . .	1,254,804	237.56	221,796	42.01	54,410	10.30	276,206	52.31	22.02
Nantucket, . .	34,185	6.47	27,290	5.17	3,770	.71	31,060	5.88	91.50
Norfolk, . .	431,008	81.63	107,994	20.45	20,619	3.91	128,613	24.36	29.84
Plymouth, . .	717,741	135.94	144,991	27.46	30,261	5.73	175,252	33.19	24.42
Suffolk, . .	56,375	10.68	6,580	1.25	3,053	.58	9,633	1.83	17.32
Worcester, . .	1,295,419	245.34	295,487	55.96	42,020	7.96	337,507	63.92	26.05
Totals, . .	7,756,455	1,469.02	1,667,938	315.90	325,705	61.68	1,993,643	377.58	25.70

Laid out on county petitions, 396,253 feet (75.05 miles).
Laid out on city petitions, 170,786 feet (32.84 miles).
Laid out on town petitions, 1,426,604 feet (270.19 miles).
Average distance petitioned for, 13,826 feet (2.62 miles).
Average length laid out, 3,105 feet (.59 mile).

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OF THE

METROPOLITAN WATER AND SEWERAGE BOARD.

JANUARY 1, 1902.

BOSTON:
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1902.

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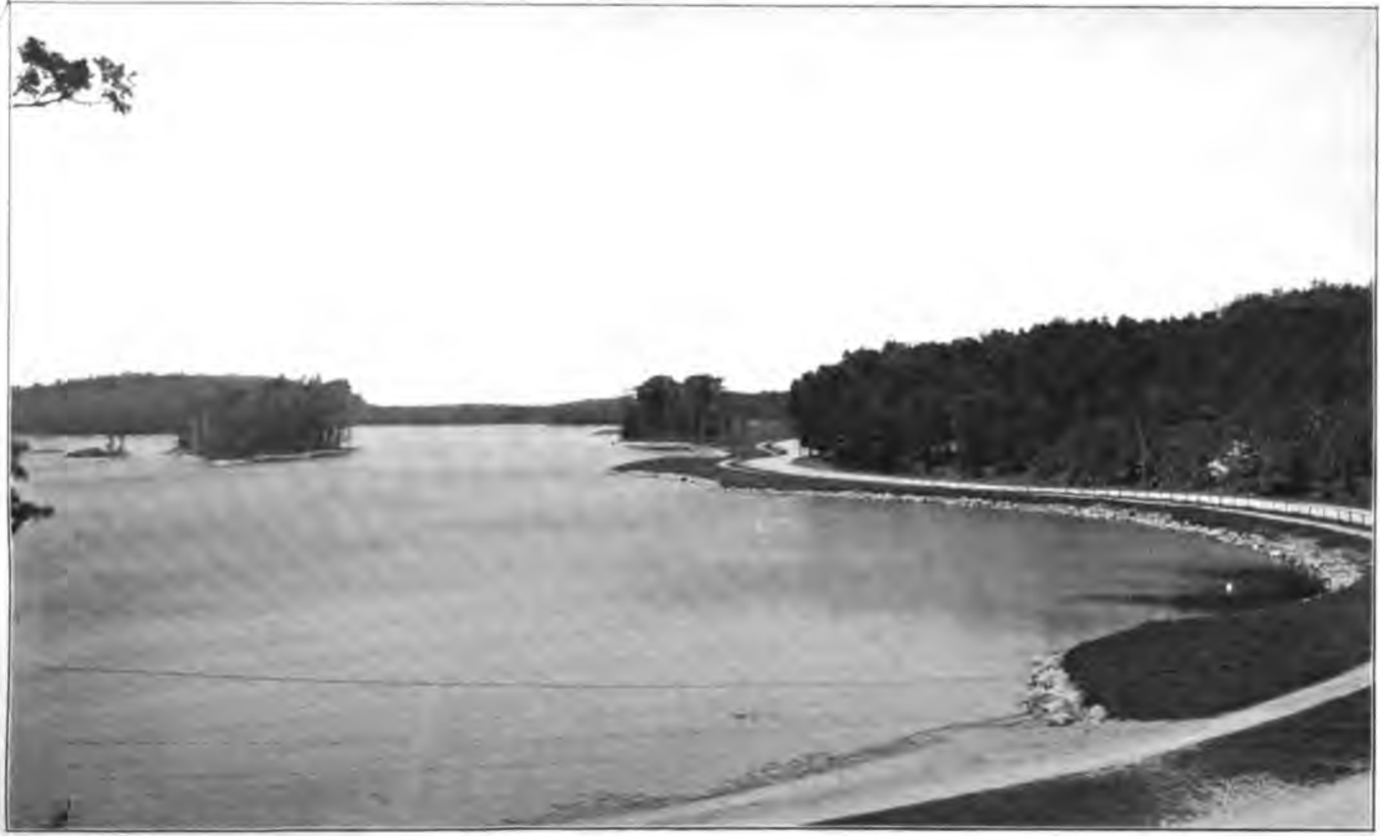


SPOT POND—View of Northwesterly Part after Improvement.

METROPOLITAN WATER AND SEWERAGE BOARD.

To the Honorable the Senate and House of Representatives of the Commonwealth of Massachusetts in General Court assembled.

The Metropolitan Water and Sewerage Board, established under the provisions of chapter 168 of the Acts of the year 1901, respectfully submits its

FIRST ANNUAL REPORT.

The Metropolitan Water Board and the Board of Metropolitan Sewerage Commissioners were consolidated by the said Act of the year 1901, which was approved and took effect on March 20. The present report is made to embrace the work and operations of the Metropolitan Water Board for the period beginning with January 1, 1901, the date of its last annual report, to March 20, 1901; and of the Board of Metropolitan Sewerage Commissioners for the period beginning with October 1, 1900, the date of its last annual report, to March 20, 1901; and of the Metropolitan Water and Sewerage Board from its organization to and including December 31, 1901. The previous report of the Water Board was the sixth annual report, and of the Sewerage Commissioners the twelfth annual report.

I. ORGANIZATION AND ADMINISTRATION.

(1) BOARD, OFFICERS AND EMPLOYÉS.

Prior to the consolidation of the two Boards, the Metropolitan Water Board consisted of Henry H. Sprague, chairman, Wilmot R. Evans and Henry P. Walcott, M.D.; and the Board of Metropolitan Sewerage Commissioners consisted of James A. Bailey, Jr., chairman, Tilly Haynes and George A. Kimball.

The consolidated Board was constituted by the appointment of Henry H. Sprague, chairman, Henry P. Walcott, M.D., and James A. Bailey, Jr. William N. Davenport was appointed secretary and executive officer of the Board, and Alfred F. Bridgman, auditor and purchasing agent. Prior to the organization of the new Board, Mr. Davenport and Mr. Bridgman had served in the same capacities in the Water Board. Herbert E. Brayton held the position of clerk and auditor of the Sewerage Commission prior to the consolidation.

The administrative office force has comprised a book-keeper, two assistant book-keepers, an assistant in auditing, a paymaster, a supply clerk, two general clerks, four stenographers, a telephone operator, two messengers, a janitor and a fireman.

Alfred C. Vinton, conveyancer, and George D. Bigelow, assistant conveyancer, of the Water Board, have continued in charge of the work of conveyancing of the consolidated Board. They have been assisted by Miss Alline E. Marcy, title examiner, and by one stenographer, and, for a portion of the time, by two stenographers. It has been necessary to employ Miss Celia M. Tibbetts a part of the time for service at the Worcester Registry of Deeds.

Frederic P. Stearns, the chief engineer of the Water Board, was appointed chief engineer of the consolidated Board, with special charge of the Water Works.

Joseph P. Davis, Alphonse Fteley and Hiram F. Mills have been continued as consulting engineers.

For the Water Works the following have also been continued in charge of the various departments: Dexter Brackett, engineer of Distribution Department; Desmond FitzGerald, engineer of Sudbury Department; Thomas F. Richardson, engineer of Dam and Aqueduct Department; Hiram A. Miller, engineer of Reservoir Department; Horace Ropes, engineer of Weston Aqueduct Department; and Alfred D. Flinn, principal office assistant.

The engineering force employed on the Water Works, in construction and maintenance, has, upon the average during the year, comprised, in addition, 9 division engineers, 33 assistant engineers and others in various engineering capacities and as sanitary inspector, clerks, stenographers and messengers, to the number of 120, — in all, 162. The maximum engineering force employed at any one time during the year on construction and maintenance was 190.

There have also been employed inspectors, other than engineering inspectors, to the maximum number of 12. Day-labor forces under the general supervision of the engineers and the immediate direction of foremen, varying in numbers from time to time, have been employed in pipe laying, in general improvements and repairs and in the performance of minor operations.

In addition, a regular maintenance force has been required at the pumping stations and upon the reservoirs, aqueducts, pipe lines and other works, numbering upon the average during the year 185. This force at the end of the year numbered 170, and was distributed among the various departments as follows: Distribution Department, 100; Dam and Aqueduct Department, 16; Sudbury Department, 54.

The maximum number of men employed upon contracts by the various contractors upon the Water Works during the year was for the week ending August 24, when the number amounted to 2,668.

William M. Brown, the chief engineer of the Sewerage Commission, was continued by the new Board as engineer of the Sewerage Works.

He has been assisted by 5 division engineers who have been in charge of the various sections of sewer construction, 12 assistant engineers, and 78 others who are employed in various engineering capacities, and as clerk, stenographer and messenger in the department. The maximum engineering force employed at any one time during the year on construction and maintenance of the works was 108.

There have also been employed inspectors, other than engineering inspectors, to the maximum number of 26. Day-labor forces under the general supervision of the engineers and the immediate direction of foremen have been employed in making connections between existing Metropolitan sewers and the sections of the sewerage works recently completed in Chelsea, Malden and Melrose, in construction of parts of Section 60 in Melrose, which had been abandoned by the contractor, and, in Section 67, the pipe crossing of Stony Brook in Hyde Park.

The maintenance force required for the Sewerage Works, exclusive of engineers before enumerated, has upon the average numbered 79. This force at the end of the year numbered 83, and was distributed between the two departments as follows: South Metropolitan System, 6; North Metropolitan System, 77.

The maximum number of men employed upon contracts by the various contractors upon the Sewerage Works during the year was for the week ending September 7, 1901, when the number amounted to 1,516.

(2) Offices and Buildings.

The office of the Metropolitan Water and Sewerage Board was established in the buildings numbered 1 and 3 Ashburton Place, at the corner of Somerset Street, which had been occupied at the beginning of the year under a lease made by the Water Board. In these buildings are located, also, the offices of the secretary, the auditor and the conveyancers, and the main engineering office of the Metropolitan Water Works. The engineering department of the Sewerage Works has continued to occupy a portion of the rooms in the Pemberton Building where the Sewerage Commissioners had been located since January 1, 1901.

The headquarters of the Wachusett Reservoir and Wachusett Dam and Aqueduct departments of the Water Works have been maintained in the office building in Clinton. Branch offices of the Wachusett Reservoir Department have been maintained at the North Dike in Clinton, at Sawyer's Mills in Boylston and in West Boylston, and a fourth was established in May in the easterly part of West Boylston. For the work of the Wachusett Dam and Aqueduct Department a branch office has been maintained at the dam. The main office of the Weston Aqueduct Department has remained in Saxonville, and branch offices have been located in Framingham Centre, Wayland and Weston. Headquarters of the Distribution and Sudbury departments have been maintained in Boston. For the Sudbury Department a branch office has been maintained at South Framingham. The headquarters for the maintenance department of the Water Works in the northern part of the District have been in buildings recently erected in the Glenwood Pipe Yard in Medford, where there are offices, shops, store rooms and stables. The maintenance force for the southern portion of the District is located in buildings at the Chestnut Hill Reservoir.

There are also maintained, in connection with the Water Works, the Chestnut Hill high-service and low-service pumping stations; the Spot Pond, Arlington and West Roxbury pumping stations; the Clinton sewerage pumping station at Clinton; the Mystic pumping station at Medford, not now operated; as well as the gate-houses at the several reservoirs, dwellings for attendants, and various other buildings for operating purposes.

There have been maintained, in connection with the construction of the Sewerage Works, branch engineering offices at Forest Hills, East Milton, Hyde Park, Hough's Neck and Melrose. In addition to the above, twenty-two portable booths have been in use along the line of the work. For the operation of the works there have been maintained the Deer Island, Charlestown, East Boston, Alewife Brook and Quincy pumping stations.

(3) Conveyancing.

The conveyancers of the Water Board had charge of the examination of titles and the preparation of deeds, instruments and other papers required in the acquisition of real estate, a work which, previous to the consolidation of the two Boards, was performed for the Sewerage Commission by attorneys appointed by the Attorney-General. Since the consolidation the former conveyancers have performed the entire work.

Considerable increase in the work of conveyancing has been made by the addition of the titles connected with the real estate acquired for the high-level sewer and the lands which are embraced in the line of the Weston Aqueduct.

Titles have been completed and the necessary papers drafted in 133 cases of settlement. Of these settlements, 106 were on account of the Water Works and 27 on account of the Sewerage Works. In the larger part of the Worcester County cases the preliminary examination of titles had been made, and it was necessary only to revise the titles to date, and to draft and obtain the necessary deeds and other instruments attending the settlement. The lands acquired along the line of the Weston Aqueduct were mostly in the county of Middlesex, and new examination of titles had to be made; and the same was the case with the sewerage titles, which were principally in the counties of Suffolk and Norfolk.

The conveyancers have also been called upon to prepare 20 instruments of taking, — 15 for the Water Works and 5 for the Sewerage Works, by which were acquired 146 estates.

One road location and two discontinuances of 4 roads and parts of 8 other roads were drafted for the Water Works.

There were pending on January 1, 1902, 43 cases in process of settlement. In about one-half of these the papers had been prepared and sent out for execution, but for various reasons there was some delay in returning them; in other cases delay was occasioned by the absence of parties, probate proceedings and the defects of titles; and an unusual number of settlements was effected in the month of December. The total number of settlements on account of the Water Works was 133, as against 116 made in the preceding year. For the Sewerage Works 7 settlements were effected before the consolidation, and 31 have been effected since the consolidation of the two Boards.

A detailed statement of the various takings and settlements is given hereafter.

The conveyancers have been called upon to do a considerable amount of work for the Attorney-General in cases for which petitions or suits for damages have been brought.

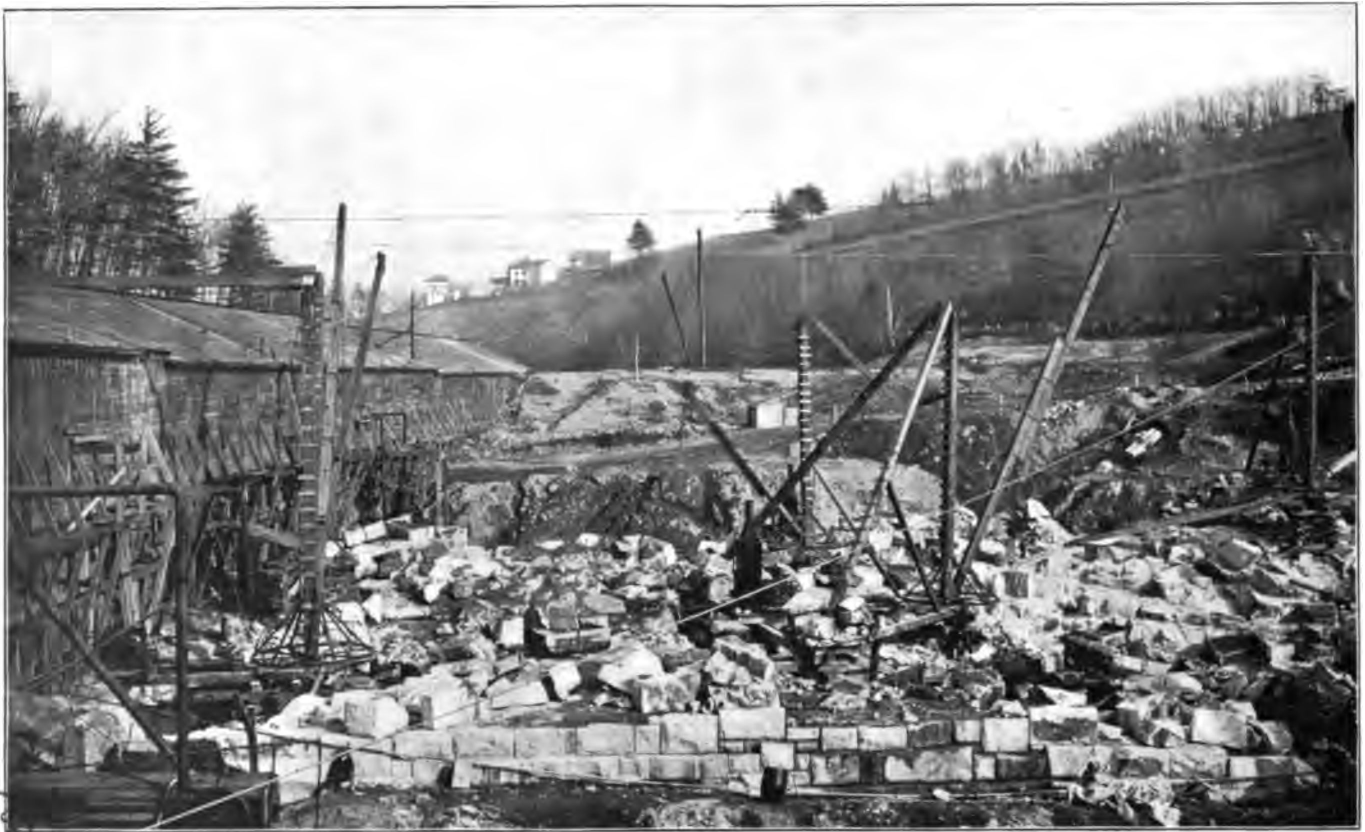
II. WATER WORKS — CONSTRUCTION.

(1) WACHUSETT DAM AND RESERVOIR.

(a) *Wachusett Dam.*

Prior to the beginning of the year, but little actual work had been accomplished under the contract for the building of the Wachusett Dam, which was executed on October 1, 1900. Considerable progress had then been made in the erection of the air-compressor plant, in the building of cableways, and in the installation of other portions of the plant for carrying on the necessary work of excavation. The compressor plant was completed early in the year, and the work of excavation was vigorously carried on. In the meantime, great progress had been made in opening up the quarry and the taking out of stone to be used in the construction of the dam. Excavation for the bed of the structure had been so nearly completed that a beginning of masonry work was made by the laying of the first stone on June 5; and, though considerable other excavation was made after that date, the laying of the stones which are to constitute the dam has been continuously carried on, so that at the end of the year, in addition to the installation of a complete plant for the work, masonry to an extent of more than 28,000 cubic yards has been laid, and for a considerable extent of surface this had reached a height of more than 40 feet above the rock bed.

The progress justifies the expectation that, in accordance with the contract, the dam will be constructed to such a height that, by the spring of 1903, considerable water can be stored behind it. November 15, 1904, is the date fixed for the entire completion of the contract.



WACHUSETT DAM — Showing Progress of Masonry Construction on December 31, 1901

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The contract price for the erection of the dam, according to the quantities estimated, was $1,603,635.00. Work has already been accomplished to an amount of $190,218.24.

(*b*) *Wachusett Reservoir.*

The work of removing the soil from the bottom of the Wachusett Reservoir has rapidly progressed during the year. Of the total amount of soil to be removed, estimated at 6,900,000 cubic yards from 4,200 acres, 3,588,648 cubic yards, or 52 per cent. of the whole, had been removed on December 31, 1901, and 2,116 acres had been stripped. During the year 1901, 1,309,925 cubic yards were removed and 1,358 acres were stripped. The removal of more than one-half of the remainder of the soil is provided for under existing contracts. Nearly all of the soil so removed has been used in the construction of the North Dike, the small amounts of 167,389 cubic yards having been taken for road embankments and 2,420 cubic yards for shallow-flowage areas. The soil is loaded into cars, either directly or after carriage in dump carts, and hauled by locomotives or up inclines to the dike.

The larger part of the area which has been stripped during the year is in the town of Boylston, but the stripping has proceeded so far as to take in a small portion of the easterly part of the town of West Boylston. Small areas in the town of Clinton have also been stripped during the year.

At the North Dike the secondary cut-off trench has been completed, and the main cut-off trench, which had been excavated and partially filled, has been substantially completed. About two-thirds of the entire amount of soil filling required for the construction of the North Dike has been deposited, and a considerable portion of the embankment has been completed on the water side of the dike, ready for the slope paving.

During the year, in West Boylston, 2 mills, 1 hotel, 1 hall, 53 dwellings and 14 barns have been torn down, removed or destroyed, making a total of 150 buildings which have so far been disposed of. Considerable work has been required for the repairing of buildings which are retained, and which are, in general, rented to people employed upon the work.

(c) *Location, Construction and Discontinuance of Roads.*

The location of a new road to be built across the reservoir in West Boylston, connecting Sterling and Lancaster streets, on the northerly side of the reservoir, with Worcester Street, on the southerly side, has been determined, and the location has been agreed to by the County Commissioners.

During the year discontinuances have been made of 12 public ways, or parts of ways, in the towns of Boylston and West Boylston.

It has been necessary to keep several of the roads, discontinued in this or preceding years, in condition for travel, for the purposes of the Board and of contractors, and considerable repairs have been required. Much work has also been done in the making of surveys for the relocation of roads at the upper end of the reservoir, which are to take the place of those hereafter to be discontinued.

The following is a list of roads, with dates of discontinuance, which have been discontinued in the year 1901, on account of the work of construction in the Wachusett Reservoir: —

LOCATION.	Description.	Date of Discontinuance.
Boylston, . . .	That part of the River Road between the southerly end of the part discontinued December 30, 1899, and the new highway from Boylston to Clinton.	June 1, 1901.
Boylston, . . .	That part of the old road from Sawyer's Mills to West Berlin leading easterly from the southerly end of that part of the River Road discontinued December 30, 1899, to the new highway from Boylston to Clinton.	June 1, 1901.
Boylston, . . .	Road leading southerly from the old road from Sawyer's Mills to West Berlin to the road from Sawyer's Mills to Berlin.	June 1, 1901.
Boylston, . . .	That part of the road from Sawyer's Mills to Berlin between the River Road and the new highway from Boylston to Clinton.	June 1, 1901.
West Boylston and Boylston.	That part of East Main Street and its continuation in Boylston and the Scar Bridge Road between Beaman Street and land of Lyman P. Kendall.	June 1, 1901.
Boylston and West Boylston.	Part of the road from Sterling to Boylston Centre leading southerly from Bruce Street to Scar Bridge Road.	June 1, 1901.
Boylston, . . .	That part of the road from West Boylston to Clinton between the continuation of East Main Street in Boylston and the road to Sterling.	June 1, 1901.
Boylston and West Boylston.	That part of the Dover Road between the easterly line of the new Shrewsbury Road and land of Lyman P. Kendall.	June 1, 1901.
West Boylston, . .	The short curved road between Temple Street and the Dover Road.	June 1, 1901.
Boylston, . . .	Road running northeasterly from the Dover Road to Scar Bridge.	June 1, 1901.
West Boylston and Boylston.	Temple Street in West Boylston and the continuation thereof called the Sand Hill Road in Boylston to land of John N. Flagg.	June 1, 1901.
Boylston, . . .	A short curved road leading easterly from the new Shrewsbury Road to the Sand Hill Road.	June 1, 1901.

(*d*) *Relocation of the Central Massachusetts Railroad.*

As the result of conferences which have been had during the year with the authorities of the Boston & Maine Railroad, formerly the lessee, now the owner, of the Central Massachusetts Railroad, additional surveys have been made for the purpose of determining upon the relocation of the railroad around the basin. No definite arrangement has been reached, but it is expected that an agreement between the Board and the railroad company will early in the year be effected, and that the construction of the new portion of the railroad will be begun. Great speed will be required in order to complete the work by the time when it will become necessary to abandon the old road-bed for the beginning of the filling of the reservoir.

(*e*) *Clinton Catholic Cemetery.*

The work of the removal of the bodies from the St. John's Catholic Cemetery in Clinton, which was included within the limits of the proposed reservoir, to the new cemetery in the town of Lancaster, had been substantially completed in the year 1900. In the progress of the more extensive excavations which were made a few additional bodies were found, and were removed by the representatives of the Cemetery Association. The total number of bodies removed was 3,872.

There is a balance due, under the tripartite agreement made between the Board, the Roman Catholic Bishop of Springfield and the St. John's Catholic Cemetery Association. The Board has been ready for the final settlement and to pay the balance due under the agreement, and to convey the lands held by it and included within the new cemetery lot to the St. John's Catholic Cemetery Association, as called for, on the receipt of a deed of the old cemetery lot, and a release of all claims and damages as provided.

(*f*) *Sanitary Inspection of Watershed.*

The watershed of the South Branch of the Nashua River above Clinton has been divided into districts, according to the natural drainage line of the brooks, and a careful inspection has been made of each of these districts as to the sources of pollution, and many cases of pollution arising from defective house drainage and other causes have been remedied. A constant examination and inspection of the camps of the laborers and of other buildings within the basin have been made by the medical inspector, Dr. J. J. Goodwin of Clinton. The general health of the people residing on the watershed and of the laborers who have been employed within the site of the reservoir has been good. Few cases of contagious diseases have occurred.

(2) Improvement of Lake Cochituate.

The Board was required, by chapter 509 of the Acts of the year 1901, which was approved on June 14, 1901, to cause those portions of Lake Cochituate which had formerly been Snake Brook Meadow and Pegan Brook Meadow to be cleaned and excavated to a level of 3 feet above the bottom of the aqueduct issuing from the lake, and the banks of the meadows to be improved so that the mud deposits should not be exposed at low stages of the water. The Act, however, provided that the amount to be expended should not exceed $100,000, and that, if the Board should find it impossible to excavate the meadows to the depths specified and to carry out the other provisions of the Act for that sum, then the Board should accomplish as much work as could reasonably be done for the said sum of $100,000. It was further required that the work should be performed within two years from the passage of the Act.

The Act called for an excavation of the meadows to a level of practically 10 feet below high water. The area included in these meadows had formerly been comparatively dry, but by the raising of the water of the lake many years ago they were covered with water to a depth of about 6 feet when the lake was full. Consequently, when the water of the lake was drawn down in periods of drought or large consumption, the mud surfaces were exposed and odors arose from the exposure of the mud.

The engineers of the Board had proposed to remedy the existing troubles by the maintenance of dams at the outlet of the meadows during the periods when the lake was drawn down, and had been of the opinion that the offensive conditions could be overcome by the expenditure of a comparatively small amount of money.

Preparations were begun immediately after the passage of the Act for the speedy prosecution of the work in accordance with its requirements. The work was rendered more difficult on account of the necessity which exists to husband all the resources of the water supply until the completion of the Weston Aqueduct, and from the fact that the work could only be effectively carried on during the period when the water of the lake was drawn down for the purposes of consumption. It is also especially difficult, during the prosecution of the work, to make proper provisions to prevent the pollution of the water supply.

The large rainfall of the summer prevented early active operations upon both areas, and it was determined to complete during the season only the improvement of the Snake Brook Meadow, the smaller one, and to confine the work upon the Pegan Brook Meadow to such preliminary operations as could be carried out during the year.

(*a*) *Snake Brook Meadow.*

A dam was erected by day labor at the outlet of the Snake Brook Meadow in the latter part of August, so as to separate the meadow from the main body of water in the lake; Snake Brook was diverted, at a point above the meadow, from its natural course, so as to flow away from the lake; and the water pumped from the meadow was also diverted from the lake. A contract was made for the excavation of the mud and for the gravelling of the embankment about the shores. In the prosecution of the work a sandy bottom was found in places at a somewhat higher level than that of the depth proposed to be reached; otherwise the mud was excavated to a level only 9 feet below high-water mark, as it was estimated that it would be impossible to carry the excavation to the depth proposed by the Act within the limit of money authorized. The improvement had been substantially completed at the end of the year, and little remains to be done except the gravelling of the embankments and finishing of the surface alongside.

(*b*) *Pegan Brook Meadow.*

It is proposed to make the improvement of the Pegan Brook Meadow by the excavation of the mud and the disposal of the material in embankments along the shores, which are to be faced with gravel, in a manner similar to that carried out in the Snake Brook Meadow. Much preliminary work has been accomplished, so as to carry on the work as speedily as possible. A temporary dam has been built, with a sluiceway, in order to separate the meadow from the lake. Pumps have been put in place and in operation, and the digging of a drainage ditch through the middle of the meadow has been begun. It is expected that the improvement can be substantially accomplished during the coming year and the following spring, within the time limited by the Act.

(3) CHESTNUT HILL AND SPOT POND PUMPING STATIONS.

The low-service pumping station at Chestnut Hill and the high-service pumping station at Spot Pond were both finally completed early in the year, and the grounds about them were put in order. The three new engines at the Chestnut Hill station and the one new engine at Spot Pond, which had been previously put in operation, received their final finishing and were accepted after the making of the official tests required.

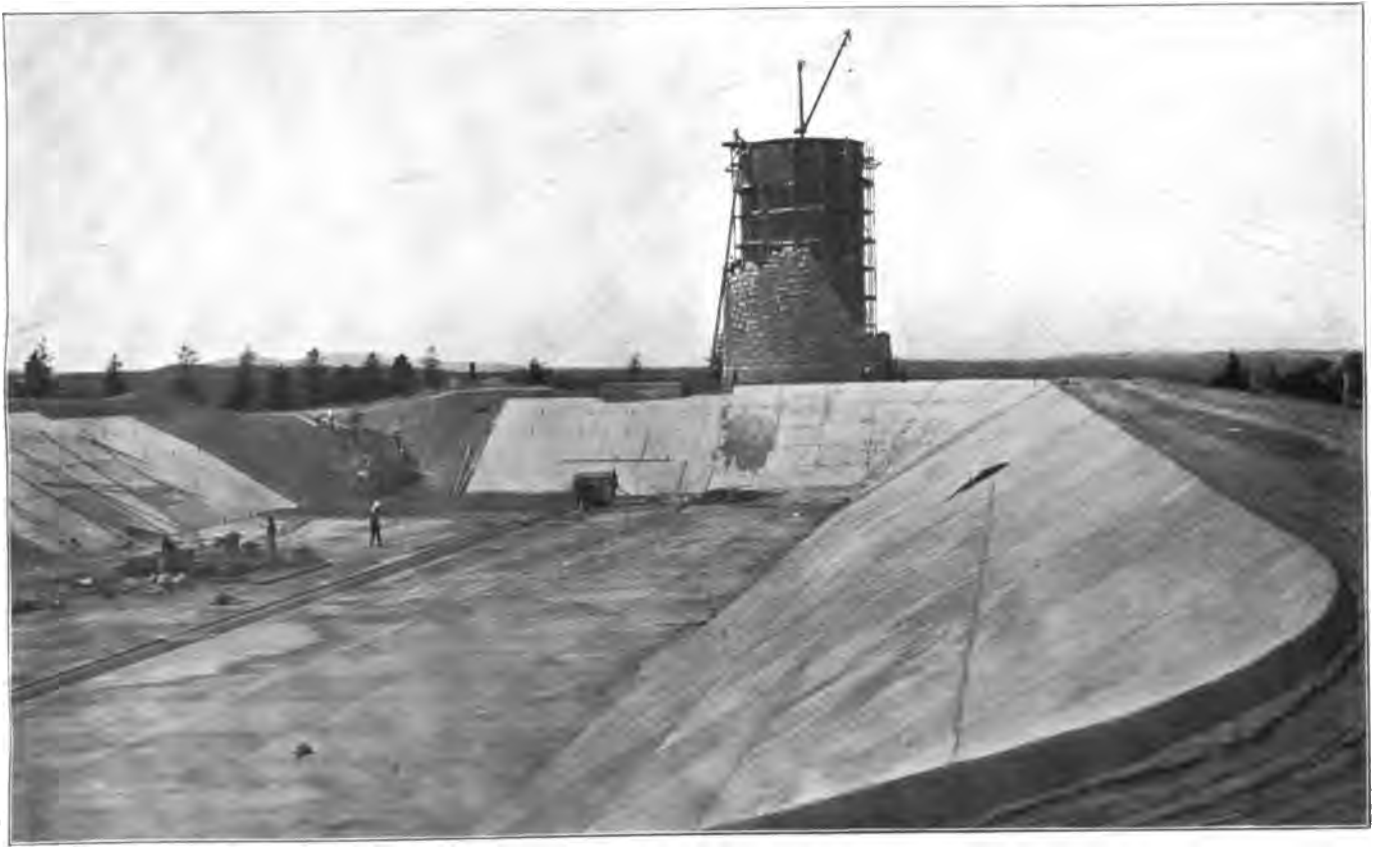
The expenditures on account of the Chestnut Hill low-service pumping station, exclusive of those for engineering, have been, for building and appurtenances, $223,613.22; for engines, boilers and their connections, $195,399.03, — a total of $419,012.25.

The expenditures on account of the Spot Pond pumping station have in like manner been for building and appurtenances, $129,811.79; for engines, boilers and their connections, $137,846.45, — a total of $267,658.24.

(4) FORBES HILL RESERVOIR AND STANDPIPE AT QUINCY.

The reservoir at Forbes Hill in Quincy, which was in process of construction at the date of the last report, has been finished and put into service. The granolithic walks around it have been laid, and the surfacing and seeding of the embankments have been accomplished. This reservoir is in the form of a rectangle, about 340 feet long and 160 feet wide at the high-water line, with sloping sides, both bottom and sides being covered with concrete. The area of water surface is 1.23 acres, the depth of the water when full is 17 feet, and it has a capacity exceeding 5,000,000 gallons.

The steel standpipe erected in connection with the reservoir was finished in the year 1900, and the construction of a masonry tower encircling the standpipe was begun during the current year, but, owing to delay in obtaining necessary granite, its completion has been delayed, but it will be finished early in the coming year. When completed, the tower will be provided with an observation roof to be reached by a spiral staircase. The tower will be 46 feet in diameter at the base and 75 feet high; and its roof, which will, in accordance with the agreement made with the city of Quincy, be open to visitors, will command a view of the country for many miles around.



FORBES HILL RESERVOIR AND STAND-PIPE — PARTIALLY CONSTRUCTED.

UNIV. OF MICH.

(5) Stoneham Pipe Lines and Bear Hill Reservoir.

The agreement made with the town of Stoneham, upon its admission into the District, required the laying of pipe lines in order to make connection with the water system of the town; and also the building of a reservoir on Bear Hill in the Middlesex Fells, in order to furnish water at a greater pressure for the town than would be supplied by the Fells Reservoir. Accordingly, a pipe has been laid from the Spot Pond pumping station around the northeasterly end of Spot Pond to the junction of Main and South streets in Stoneham, and thence one branch laid to the Bear Hill Reservoir and another to Stoneham Square to a connection with the main pipe of the town. The entire length of pipe line laid was 12,216 feet. The line to Stoneham Square was completed and the town of Stoneham supplied with water on October 21.

The building of the reservoir near the summit of Bear Hill was begun and brought nearly to completion during the year. This reservoir is built across a depression in the rocky ridge forming the hill at a height 137 feet above the surface of Spot Pond. All of the earth, beside considerable rock, was excavated from the area enclosed, and the reservoir has a capacity to hold 2,000,000 gallons of water. Connection was made with the pipe line from Spot Pond, and the work was so far advanced at the end of the year that the reservoir was partly filled with water.

(6) Weston Aqueduct and Reservoir.

The surveys and other preliminary work had been begun at the end of the preceding year, and had so far advanced in the early spring of this year that it was possible to determine the final location and design of the aqueduct. The aqueduct extends from the Sudbury Dam in Southborough through portions of Framingham, Wayland and Weston, a distance of 13.44 miles. Of this distance, 9.14 miles will be of covered masonry, built in open trench, 2.30 miles in five different tunnels, 1.02 miles in open channel and reservoir, and the remainder in pipe lines, to connect at the beginning with the Sudbury Reservoir, and steel siphon pipes across the valleys of the Sudbury River and of Happy Hollow in Wayland. The aqueduct will in general be of horse-shoe form, like that of the Wachusett Aqueduct, and will have a capacity of 300,000,000 gallons daily.

List of Takings for Metropolitan Water Works from January 1, 1901, to December 31, 1901.

No.	LOCATION AND DESCRIPTION.	Former Owners.	Recorded.	Purpose of Taking.
70	Newton (on Manet Road and Ward Street). Area, 5.09 acres in fee.	City of Newton.	**1901.** Mar. 5.	Waban Hill Reservoir.
71	Clinton and Lancaster (High Street and Mill Street, respectively). Area, 23.20 acres in fee.	John H. Livingston, Isaac Gilmour *et al.*	Mar. 8.	Clinton sewerage.
72	Arlington Heights (between Cedar Avenue and Park Avenue). Area, 0.115 acre in fee.	Town of Arlington.	Mar. 11.	Arlington Standpipe and pipe lines.
73	Marlborough (on Farm and Parmenter streets). Area, 91.57 acres in fee.	M. Evelyn Temple, Ann E. Golbert *et al.*	Mar. 14.	Sudbury Reservoir.
74	Southborough (northeasterly part on Marlborough boundary line). Area, 29.18 acres in fee.	Ann E. Golbert *et al.*	Mar. 13.	Sudbury Reservoir.
75	Marlborough (on Southborough and Northborough boundary lines). Area, 15.05 acres in fee.	John A. Gilmore.	Mar. 14.	Wachusett Aqueduct.
76	Southborough and Northborough (on Marlborough boundary line). Area, 0.40 acre in fee.	John A. Gilmore.	Mar. 14.	Wachusett Aqueduct.
77	Stoneham (Woodland Road and Pond Street). Area, 12.93 acres in fee.	Elizabeth H. Moffitt *et al.*	Mar. 14.	Spot Pond improvement.
78	Marlborough (southeasterly from Farm Street). Area, 9.8 acres in fee.	William Barnes.	Mar. 19.	Sudbury Reservoir.
79	Boylston (northeasterly part, southwesterly from Boston & Maine Railroad, Central Massachusetts Division). Area, 4.27 acres in fee.	Alfred G. Larkin.	April 5.	Wachusett Reservoir.
80	Southborough (easterly part, near the Sudbury Dam). Area, 0.81 acre in fee.	Benjamin H. Clemons and Comer A. Belknap.	May 18.	Weston Aqueduct.
81	Framingham, Wayland and Weston (from Southborough line to Sudbury River, and from land of Walter Reeves, in Wayland, to a point a short distance easterly from Wellesley Street, in Weston). Area, 132.70 acres in fee; easements in 8.28 acres; and various rights in 17.41 acres.	Comer A. Belknap *et al.*	May 18.	Weston Aqueduct.
82	Framingham, Wayland and Weston (from Sudbury River easterly to land of Thomas and Anthony Irving, and from land of Irvings to land late of Joseph O. Bullard *et als.*, in Wayland, and from land late of James Cooper southeasterly to Loring Street, in Weston). Area, 79.81 acres in fee; easements in 2.49 acres; and various rights in 12.89 acres.	Charles F. Stone *et al.*	Aug. 31.	Weston Aqueduct.
83	Wayland (on both sides of road from Saxonville to Weston). Area, 6.82 acres in fee; easements in 0.10 acre; and various rights in 0.40 acre.	Thomas and Anthony Irving.	Aug. 31.	Weston Aqueduct.
84	West Boylston and Sterling (north of Oakdale Station, between Pleasant Street and North Main Street, mostly covered by waters of mill pond). Area, 164.40 acres in fee.	West Boylston Manufacturing Company *et al.*	Oct. 9.	Wachusett Reservoir.

Of all the land taken or acquired by the Board for the Metropolitan Water Works since the beginning of operations, aside from the works of Boston, Malden, Medford and Melrose, settlements have been effected with the owners of all but 930.063 acres.

In by far the larger part of the cases, purchases of the territory had been made prior to the taking, and the territory purchased, as well as that not purchased, was embraced in the takings made.

Settlements under such purchases and takings for all purposes of the Water Works have been effected in the past year in 65 cases, and for an aggregate of 495.71 acres with the buildings thereon. The sums paid in these settlements have amounted to $151,697.85. In only 3 of these cases have the settlements been results of suits at law, and the total amount paid in the court settlements has been $11,315.57.

Since the beginning of operations upon the Metropolitan Water Works the number of settlements of this kind effected for the purposes of the Water Works has amounted to 655, and under them the Board has acquired rights, in fee or in easement, in 10,875.84 acres, or 17 square miles, for which an aggregate of $3,456,116.05 has been paid. Only 9 of these cases have been settled by suits at law, and the total amount paid under judgments of the court has been $32,753.04, or less than 1 per cent. of the whole.

These purchases and takings include lands taken in fee with the buildings thereon, and water and other rights connected therewith, and lands in which easements and other rights are taken; but they do not include settlements for diversion of water, depreciation and other damages connected with lands not acquired, and in which no fee or easement has been taken.

Summary of Land Settlements for Water Works to December 31, 1901.

LOCATION.	FOR THE YEAR 1901.			FROM BEGINNING OF WORK.		
	Area in Acres.	Number of Settlements.	Payments.	Area in Acres.	Number of Settlements.	Payments.
*Wachusett Reservoir.**						
Clinton, . . .	26.16	32	$116,493 11	1,184.32	335	$2,535,340 18
Boylston, . . .	70.69			3,561.93		
West Boylston, . .	157.86			1,476.96		
Sterling, . . .	100.43			661.91		
Lancaster, . . .	–			69.97		
Holden, . . .	–			167.00		
Total, . . .	355.14	32	$116,493 11	7,122.09	335	$2,535,340 18

* Including payments on account of St. John's Catholic Cemetery.

Summary of Land Settlements for Water Works to December 31, 1901 — Concluded.

LOCATION.	FOR THE YEAR 1901.			FROM BEGINNING OF WORK.		
	Area in Acres.	Number of Settlements.	Payments.	Area in Acres.	Number of Settlements.	Payments.
Wachusett Aqueduct.						
Berlin, ...	-	1	$500 00	46.51	61	$69,212 40
Boylston, . . .	-			.38		
Northborough, . .	-			82.56		
Southborough, . .	.95			77.31		
Marlborough, . .	-			50.62		
Clinton, . . .	-			13.51		
Total, . . .	.95	1	$500 00	270.89	61	$69,212 40
*Sudbury Reservoir.**						
Southborough, . .	-	-	-	1,995.58	150	$658,318 75
Marlborough, . .	-			750.98		
Total, . . .	-	-	-	2,746.56	150	$658,318 75
Improving Sudbury Watershed.						
Northborough, . .	12.49	4	$758 00	127.01	32	$11,699 10
Southborough, . .	-			2.66		
Westborough, . .	1.00			202.48		
Ashland, . . .	-			.63		
Marlborough, . .	-			.74		
Total, . . .	13.49	4	$758 00	333.52	32	$11,699 10
Clinton Sewerage System.						
Clinton, . . .	.64	10	$2,540 00	4.65	30	$20,501 50
Lancaster, . . .	.52			81.73		
Total, . . .	1.16	10	$2,540 00	86.38	30	$20,501 50
Weston Aqueduct.						
Weston, . . .	78.71	16	$30,406 74	222.07	23	$58,060 24
Framingham, . .	44.35			62.35		
Wayland, . . .	1.60			1.60		
Total, . . .	124.66	16	$30,406 74	286.02	23	$58,060 24
Distribution System.						
Boston, . . .	-	2	$1,000 00	.70	24	$102,983 88
Brookline, . . .	-			.05		
Arlington, . . .	-			1.80		
Malden, . . .	-			.16		
Medford, . . .	-			2.39		
Newton, . . .	-			.06		
Quincy, . . .	-			5.23		
Stoneham, . . .	.31			19.99		
Total, . . .	.31	2	$1,000 00	30.38	24	$102,983 88
Aggregates, . .	495.71	65	$151,697 85	10,875.84	655	$3,456,116 05

* Including settlements made by city of Boston.

(10) CLAIMS AND SETTLEMENTS FOR LOSS OF BUSINESS.

Additional claims for injury to business by the carrying out of the Metropolitan Water Act in the towns of West Boylston and Boylston, and in a portion of the town of Sterling, have been filed during the year ending December 31, 1901, to the number of 28. Settlements of such claims have been effected during the year in 48 cases, under which the sum of $10,337 has been paid. The total number of claims of this class settled has been 207, in which a total sum of $52,267 has been paid. Claims to the number of 15 have been disallowed during the year, but the votes disallowing 2 of the claims were reconsidered, and settlements thereon effected.

Chapter 505 of the Acts of the year 1901 provided that any person living within the part of the town of Clinton within the limits of the proposed reservoir should be allowed damages for loss of or injury to business, and under this act 2 additional claims have been filed.

(11) CLAIMS AND SETTLEMENTS FOR LOSS OF EMPLOYMENT.

During the year ending December 31, 1901, 236 claims for damages for loss of employment by residents of West Boylston have been filed. Settlements have been made in 169 cases, the amount paid being $34,438.50. During the year 70 claims have been disallowed, and votes previously passed disallowing 4 claims were afterwards reconsidered, and settlements thereon have been made. The whole number of claims filed up to December 31, 1901, has been 550; the total number of settlements effected has been 452, and the total amount paid on account of these claims has been $82,171.41.

(12) CLAIMS AND SETTLEMENTS FOR DEPRECIATION OF REAL ESTATE.

Settlements of claims for injury to real estate in the town of West Boylston, and in portions of the towns of Boylston, Clinton and Sterling, have been effected in 42 cases, and the sum of $16,785 has been paid. The total number of claims of this class settled to December 31, 1901, has been 83, and the total amount paid thereon has been $39,520. In all the remaining cases in West Boylston, in which application has been made for damages by owners of such real estate, offers of settlement have been made by the Board.

(13) CLAIMS OF THE CITIES OF BOSTON, MALDEN, MEDFORD AND MELROSE.

Settlement had been effected with the city of Boston at the time of the last report, by which the entire damages on account of the taking, on January 1, 1898, of the sources of water supply and other property of that city, were fixed at $12,531,000, payable as of November 1, 1900. Of this sum, $5,000,000 had been previously paid on account, leaving due to the city of Boston the sum of $7,531,000, with interest from November 1, 1900, at the rate of 3½ per cent. per annum. By the passage of chapter 453 of the Acts of the year 1901, providing for an additional Metropolitan Water Loan, the Treasurer of the Commonwealth was enabled to make a final settlement of the judgment made in favor of the city. Payments were made to the city of Boston of a total additional sum of $7,768,948.80, which included interest to the amount of $237,925.16 and costs of suit $23.64, the final payment being made on October 29, 1901.

Some negotiations have been had with the authorities of Malden, Medford and Melrose, with a view to the settlement of the claims of these cities on account of the taking of Spot Pond and adjoining lands, with the pumping stations thereon. Offers have been made to these cities, but no settlements have yet been effected, although the sum of $25,000 has been paid to the city of Malden on account.

III. WATER WORKS — MAINTENANCE.

(1) OPERATION OF WORKS.

All the cities and towns included in the Metropolitan Water District were supplied with water from the Metropolitan Works in the year 1901, except Newton and Hyde Park. The cities and towns supplied were Boston, Chelsea, Everett, Malden, Medford, Melrose, Quincy, Somerville, Arlington, Belmont, Nahant, Revere, Stoneham, Swampscott, Watertown and Winthrop. Newton and Hyde Park have as yet received no water from the Metropolitan System, as their own works have been adequate for their supply. The town of Stoneham, which was admitted into the District during the year, was supplied with water from the Wakefield Water Company until October 21, after which date it was supplied from the Metropolitan Works. The Wakefield Water Company supplied to Stoneham a total of 193,400,000 gallons. The city of Medford supplied from local sources 21,200,000 gallons. All the rest of the water supplied during the year, amounting to 36,830,240,000 gallons, was furnished from the Metropolitan Water Works.

(2) Storage Reservoirs.

There are nine completed storage reservoirs having capacities as follows: —

NAME.	Capacity in Gallons.
Lake Cochituate, including Dudley Pond,	2,242,400,000
Sudbury Reservoir,	7,253,500,000
Framingham Reservoir No. 1,	287,500,000
Framingham Reservoir No. 2,	529,900,000
Framingham Reservoir No. 3,	1,183,500,000
Ashland Reservoir,	1,416,400,000
Hopkinton Reservoir,	1,520,900,000
Whitehall Reservoir,	1,256,900,000
Farm Pond,	167,500,000
Total,	15,858,500,000

The Wachusett Reservoir when completed will have a capacity of 63,068,000,000 gallons.

At the beginning of the year the storage reservoirs contained but slightly more than one-half of their total capacity, and the amount of water decreased until March 4, when the reservoirs contained but about two-fifths of their total capacity. The rains of the succeeding three months caused a rapid filling of the reservoirs, and at no time later in the year were they seriously drawn down.

The various sources of supply furnished to the District an average of about 105,000,000 gallons per day. An average of 64,299,000 gallons per day was drawn from the Wachusett Reservoir through the Wachusett Aqueduct into the Sudbury Reservoir. There was drawn from the Sudbury Reservoir and Framingham Reservoir No. 3 an average of 84,930,000 gallons per day. An average of 5,398,000 gallons per day was drawn from Framingham reservoirs Nos. 1 and 2; an average of 1,489,000 gallons per day was turned into Lake Cochituate, and the remainder conveyed by the Sudbury Aqueduct into the District. An average of 14,890,000 gallons per day was drawn from Lake Cochituate and conveyed to the District through the Cochituate Aqueduct.

(3) DISTRIBUTING RESERVOIRS.

The distributing reservoirs are six in number, and there are two standpipes, of all of which the total capacity is 2,178,780,000 gallons, as follows: —

NAME.	Capacity in Gallons.
Spot Pond,	1,791,700,000
Chestnut Hill Reservoir,	300,000,000
Fells Reservoir,	41,400,000
Mystic Reservoir,	26,200,000
Waban Hill Reservoir in Newton,	13,500,000
Forbes Hill Reservoir in Quincy,	5,100,000
Forbes Hill Standpipe,	330,000
Arlington Standpipe,	550,000
Total,	2,178,780,000

The Chestnut Hill Reservoir is now perhaps more especially to be regarded as an equalizing reservoir. Into all the others of these reservoirs water is pumped, and from them water is supplied by gravity.

These reservoirs are available not only for the purposes of distributing the water supply, but they have an added value in giving a great protection to the District, from the fact that they afford a supply stored within the District, which would be sufficient, when they are full, for about three weeks' consumption, in case the sources of supply were cut off by accident or otherwise.

(4) AQUEDUCTS.

The Sudbury Aqueduct has been in constant service during the year except upon the few days when it was necessary to empty it for the purpose of cleaning. It has conveyed, upon an average, 90,328,000 gallons per day. A considerable portion of the time the aqueduct has been run to the full extent to which it is capable, and great care has been required for the prevention of accidents and overcharging.

The Cochituate Aqueduct has been in use about 307 days, and consequently an opportunity has been had for extensive cleanings and for the making of necessary repairs. It has conveyed, upon an average, 14,890,000 gallons per day.

The Wachusett Aqueduct has required but few repairs during the year, and has been in operation 340 days. The flow through the aqueduct has averaged 64,299,000 gallons per day.

(5) Pumping Stations.

All the water furnished by the Metropolitan Works, with the exception of 102,890,000 gallons taken from the Brookline Reservoir in consequence of repairs to the city of Boston pipe lines, has been pumped at the two Chestnut Hill pumping stations.

Water has been pumped at the low-service station to Spot Pond, and thence pumped again for the northern high service to the Fells Reservoir. The small supply required for the southern extra high service in West Roxbury and for the northern extra high service in Arlington has been pumped respectively at the small stations maintained in West Roxbury and Arlington. The present daily pumping capacity of all the stations is 204,500,000 gallons, and there has been pumped at all the stations during the year an average of 109,610,000 gallons per day.

At the Chestnut Hill high-service station the new Allis engine has pumped more than 80 per cent. of the entire quantity of water pumped at this station. The cost per million gallons of raising water one foot high at this station was $0.03, which was almost the same as in the preceding year, while the total quantity pumped at the station was about two-thirds as great and the cost of coal was $0.57 per ton greater. Two new boilers have been provided to replace boilers installed seventeen years ago.

The three new Holly engines at the Chestnut Hill low-service station have been in successful operation during the year, and have pumped about 71 per cent. of the total amount of water supplied by the Metropolitan Works. The cost per million gallons raised one foot was $0.031.

The new Holly engine at the Spot Pond station has pumped nearly all of the water at this station, at a cost of $0.041 per million gallons for raising water one foot high.

The old engines and boilers at the West Roxbury pumping station have been replaced by others of a larger capacity. The new engines have been in operation about six months, and a saving of between 30 and 40 per cent. in amount of coal burned has been effected. Considerable enlargement has been required at the Arlington pumping station. At the West Roxbury and Arlington stations, owing to the much smaller quantities of water pumped, the cost per million gallons raised one foot high was, respectively, $0.299 and $0.109.

Of the entire quantity of water pumped during the year, — 40,018,920,000 gallons, — 39,774,060,000 gallons were pumped in the three large stations. A saving of $0.82 per million gallons pumped has been effected this year from the cost of last year. The reduction in cost has been largely brought about not only by the discontinuance of most of the smaller stations, but by the introduction of more economical machinery and methods at the few large stations. The cost of pumping per million gallons, of $9.64 in the year 1897, has been reduced to $2.52 in the year 1901.

(6) CLINTON SEWERAGE AND FILTRATION WORKS.

The Clinton sewerage and filtration works have been in operation during the entire year, and the amount of sewage pumped and filtered has exceeded by more than one-third the amount so disposed of during the previous year. The cost per million gallons raised one foot high by the pumping engine at the pumping station was $0.18. The cost per million gallons of water filtered at the filter-beds was $8.39.

(7) SANITARY INSPECTION AND REGULATIONS.

The work of inspecting the Cochituate, Sudbury and Wachusett watersheds for the purpose of securing proper sanitary conditions and preventing pollution of the water and contamination from infectious diseases has been continued during the year. The work of the sanitary inspector and his assistant has been devoted largely to these watersheds, though they have to a considerable extent assisted the medical inspector in attention to the Wachusett Reservoir site, which is under the supervision of the engineers having charge of the works of construction.

The number of premises in the Sudbury and Cochituate watersheds recorded as inspected has been 981, but this number does not include a large number of premises which were found on inspection to be in satisfactory sanitary condition. Of the unsatisfactory cases, 162 were remedied by sewer connection, and 160 old cesspools were abandoned. In 10 other cases a complete remedy has been effected, and in 14 a partial remedy only.

In several towns the local boards of health have actively co-operated in compelling owners along the line of sewers to make connections with them.

The results have been a very marked improvement effected in the sanitary condition of the watersheds. The unsatisfactory condition along the line of Marlborough Brook, which empties into the Marlborough filter-beds, has, however, continued, but it is understood that measures are in progress by the city of Marlborough for a radical remedy of the troubles.

Upon the consolidation of the Metropolitan Water Board and Sewerage Commission, it was deemed advisable to readopt the rules made by the State Board of Health for the sanitary protection of the waters used by the Board for water supply, and to readopt and republish the special regulations made by the Board under them in regard to fishing, boating and ice cutting. The Board has also republished and called especial attention in the Wachusett watershed to Rule 4 of the rules of the State Board of Health, prohibiting the discharge of house slops, sink waste, water used for washing or cooking, or other polluted water, into any waters used by the Board as a source, or for the conveyance, storage or distribution of the water supply.

IV. WATER WORKS—FINANCIAL STATEMENT.

(1) Metropolitan Water Loan, Receipts and Assessments.

The appropriations for the construction and acquisition of the Metropolitan Water Works, the receipts which are added to these appropriations, the expenditures for the construction and acquisition of works, and the balances available on January 1, 1902, have been as follows: —

Appropriation under chapter 488 of the Acts of 1895, . . .	$27,000,000 00
Appropriation under chapter 453 of the Acts of 1901, . . .	13,000,000 00
	$40,000,000 00
Proceeds from the sales of property applicable to the construction and acquisition of works (of which $9,690.94 is for the year 1901), ...	31,107 58
	$40,031,107 58
Amount approved by the Metropolitan Water Board and the Metropolitan Water and Sewerage Board for payments to December 31, 1901 (of which $9,404,915.19 is for the year 1901), .	29,432,332 03
Balance January 1, 1902, ...	$10,598,775 55

The Treasurer of the Commonwealth, under the authority given him to issue from time to time, on the request of the Board, negotiable bonds to an amount not exceeding $40,000,000, to be designated the "Metropolitan Water Loan," has sold bonds as follows: —

DATE.	Bonds sold.	Rate (Per Cent.).	Time (Years).	Price.	Premiums (in Amount).
1895, . . .	$2,225,000	3½	40	$110 67	$237,407 50
1896, . . .	2,775,000	3½	40	110 67	296,092 50
1896, . . .	2,000,000	3½	39	106 76268	135,253 60*
1897, . . .	6,000,000	3½	38½	107 82	469,200 00
1898, . . .	2,000,000	3½	40	113 176	263,520 00
1898, . . .	2,000,000	3½	40	112 877	257,540 00
1899, . . .	3,000,000	3	40	100 64	19,200 00
1900, . . .	1,000,000	3	39	102 78	27,800 00
1901, . . .	3,000,000	3	40	102 78	83,400 00
1901, . . .	100,000	3	40	100 375	375 00
1901, . . .	150,000	3	40	100 10	150 00
1901, . . .	205,000	3	39½	100 25	512 50
1901, . . .	50,000	3	39½	100 25	125 00
1901, . . .	50,000	3	39½	100 50	250 00
1901, . . .	300,000	3	39½	100 10	300 00
1901, . . .	200,000	3	39½	100 25	500 00
1901, . . .	3,100,000	3½	39½	106 71	208,010 00
1901, . . .	1,345,000	3	39½	100 00	–
1901, . . .	1,500,000	3	39½	100 00	–
	$31,000,000				$1,999,636 10

* Including $18,673.60 from readjustment of rate made by the Treasurer in 1897.

The sinking fund established by the Treasurer of the Commonwealth has amounted at the end of each year to sums as follows: —

December 31, 1895, ...	$226,286 05
December 31, 1896, ...	699,860 70
December 31, 1897, ...	954,469 00
December 31, 1898, ...	1,416,374 29
December 31, 1899, ...	1,349,332 97
December 31, 1900, ...	1,573,619 72
December 31, 1901, ...	1,662,426 95

From the beginning of the work until June 30, 1901, payments for the maintenance and operation of the works were made from the loan fund, and miscellaneous receipts were credited to the same fund, inasmuch as, according to the original Water Act, the amount to be assessed each year upon the District was limited, and the amount was not in any year sufficient for the payment of maintenance and operation expenses in addition to the interest and sinking fund requirements.

Chapter 489 of the Acts of 1901, however, provided that thereafter assessments should be made each year upon the cities and towns of the District, sufficient for the entire payment of interest, sinking fund requirements and the maintenance and operation of the works for the year. In accordance with the provisions of this Act, the State Treasurer has transferred to the loan fund the amount which had from time to time been paid from it for maintenance and operation, and has also applied the receipts for the year, as required by the provisions of the original Water Act, in part to the loan fund and in part to the sinking fund, and has, also, transferred to the sinking fund certain receipts which had originally been credited to the loan fund.

Allowances for water furnished from their own sources by cities and towns during the year ending May 31, 1901, were made, in accordance with the Metropolitan Water Act, as follows: —

Medford, ...	$254 40
Stoneham, ...	954 00

After deducting these allowances, the net assessments for the year 1901, made by the Treasurer of the Commonwealth, for the payment of the interest on the bonds issued by the Commonwealth, the sinking fund requirements and the expenses of operation and maintenance of the water works, were as follows: —

Arlington, . . .	$8,419 30	Newton, ...	$6,829 01
Belmont, ...	4,264 90	Quincy, ...	22,004 38
Boston, ...	1,169,105 62	Revere, ...	10,051 21
Chelsea, ...	29,570 40	Somerville, . . .	56,816 76
Everett, ...	21,731 22	Stoneham, . . .	4,710 91
Hyde Park, . . .	1,992 40	Watertown, . . .	9,800 16
Malden, ...	30,548 40	Winthrop, . . .	6,217 85
Medford, . . .	18,022 59		
Melrose, ...	12,546 32		$1,415,209 41
Nahant, ...	2,577 98		

The comparatively smaller sums assessed upon the city of Newton and the town of Hyde Park were owing to the fact that neither of these municipalities had reached the safe capacity of its sources, and consequently neither had been furnished with water.

The proceeds from the operations of the Board, exclusive of the proceeds from sales of property, have been, according to the provisions of the Water Act, applied to the payment of interest and sinking fund requirements and the maintenance and operation of works, as follows: —

For the year 1901, ... $21,372 76

The expenditures for the maintenance and operation of the Metropolitan Water Works have been as follows: —

For the year 1901, ... $304,835 24

Sums have been received during the year 1901, under the provision of the Metropolitan Water Act, in payment for admission to the District and for water furnished, as follows: —

Stoneham, for admission to District, ...	$30,000 00
Swampscott, for water furnished, ...	2,500 00
Revere Water Company, for water furnished, . . .	12,204 29
Framingham Water Company, for water furnished, . .	302 40
Lexington, for water furnished, ...	259 80
	$45,266 49

At the close of the year, the Treasurer, in accordance with the requirements of the Act, has distributed to the cities and towns of the District, in proportion to the annual assessments theretofore contributed by them, this amount, as follows: —

Arlington, ...	$269 07	Newton, ...	$218 25
Belmont, ...	136 30	Quincy, ...	703 23
Boston, ...	37,362 78	Revere, ...	321 22
Chelsea, ...	945 02	Somerville, ...	1,815 77
Everett, ...	694 50	Watertown, ...	313 20
Hyde Park, ...	63 67	Winthrop, ...	198 71
Malden, ...	976 28	Balance, ...	181 04*
Melrose, ...	400 96		
Medford, ...	584 10		$45,266 49
Nahant, ...	82 39		

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* This amount will remain undistributed until next year.

(2) Expenditures for the Different Works.

The following is a summary of the expenditures made in the various operations for the different works: —

CONSTRUCTION AND ACQUISITION OF WORKS.	For the Year ending December 31, 1901.		From Beginning of Work, and ending December 31, 1901.	
Administration applicable to all parts of the construction and acquisition of the works,		$27,640 38		$174,672 65
Wachusett Dam and Reservoir: —				
Wachusett Dam,	$189,841 42		$460,915 60	
North Dike,	96,238 22		515,046 70	
South Dike,	1,127 51		4,951 69	
Removal of soil,	423,495 97		1,109,004 08	
Relocation of railroads,	8,042 66		14,829 39	
Roads and bridges,	8,738 84		284,977 43	
Real estate,	146,571 80		2,775,531 22	
Damages, real estate not taken, business, and loss of wages,	61,560 50		173,958 41	
Other expenses,	1,462 36	937,078 78	2,593 08	5,341,807 55
Improving Wachusett watershed,		2,000 50		14,808 36
Wachusett Aqueduct,		2,209 10		1,779,520 77
Sudbury Reservoir,		2,004 32		2,922,113 78
Protection of Sudbury supply,		3,247 55		119,662 86
Improving Sudbury watershed,		1,061 10		88,814 96
Protection of Cochituate supply,		2,250 00		9,000 00
Improving Lake Cochituate,		25,838 54		25,838 54
Pipe lines, Dam No. 3 to Dam No. 1,		-		48,471 48
Pipe line, Rosemary siphon,		-		23,142 98
Weston Aqueduct: —				
Aqueduct,	$314,992 23		$336,521 13	
Reservoir,	10,944 30		14,891 30	
Supply pipe lines,	6,335 03		6,767 97	
Real estate, taxes and other expenses,	35,432 82	367,704 38	64,299 18	422,479 58
Distribution system: —				
Low service: —				
Pipe lines and connections,	$6,780 31		$1,467,446 25	
Pumping station, Chestnut Hill,	48,774 30		458,990 46	
Reservoir, Spot Pond,	10,823 97		575,520 19	
Gate-house and connections, Chestnut Hill Reservoir,	8,208 75		65,382 55	
Real estate and other expenses,	1,272 70		79,124 73	
Northern high service: —				
Pipe lines and connections,	54,135 78		438,990 88	
Spot Pond pumping station,	42,356 42		290,282 54	
Fells Reservoir, Stoneham,	337 43		141,370 86	
Bear Hill Reservoir, Stoneham,	22,940 71		23,453 27	
Real estate and other expenses,	8 85		14,373 85	
Amounts carried forward,	$196,139 17	$1,370,534 65	$3,554,935 58	$10,969,828 51

CONSTRUCTION AND ACQUISITION OF WORKS.	For the Year ending December 31, 1901.		From Beginning of Work, and ending December 31, 1901.	
Amounts brought forward,	$196,139 17	$1,370,584 65	$3,554,935 58	$10,969,828 51
Distribution system — *Con.*				
Southern high service: —				
Pipe lines and connections,	1,713 67		502,582 78	
Pumping station, Chestnut Hill,	1,253 19		241,759 61	
Forbes Hill Reservoir, Quincy,	40,196 96		68,675 37	
Waban Hill Reservoir, Newton,	1,562 11		1,562 11	
Real estate and other expenses,	5 00		10,222 84	
Northern extra high service,	876 61		12,856 12	
Southern extra high service,	11 67		380 30	
Glenwood Pipe Yard,	82 97		33,100 59	
Chestnut Hill Pipe Yard,	1,836 00	243,677 85	11,063 98	4,437,139 23
Diversion of water, south branch of Nashua River,*		46,182 50		1,087,087 89
Examination of existing water works and payments on account of same: — †				
To Boston,	$7,768,948 80		$12,768,948 80	
To Malden (on account),	-		25,749 71	
To Newton,	-		60,000 00	
	$7,768,948 80		$12,854,698 51	
Transfers of engines, boilers and other property from works purchased to other portions of the work and included in the above accounts,	-		20,558 65	
			$12,834,139 86	
Engineering, conveyancing, etc.,	877 61	7,769,826 41	24,107 60	12,858,247 46
Pipes, valves, etc., sent to store yard and not yet transferred to works,		-		80,028 89
		$9,430,170 91		
Less value of pipes, valves, etc., purchased and sent to store yards in previous years, but transferred to works, and included in cost of same for current year,		25,255 72		-
Total for constructing and acquiring of works,		$9,404,915 19		$29,432,332 03

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* Of the total expenditures from the beginning of the work, the sum of $124,304.57 is for Clinton sewerage system.

† In addition to the amounts paid for existing water works, the city of Boston was reimbursed the sum of $1,154,766.84 for moneys paid by said city in connection with the building of the reservoir in Southborough (now Sudbury Reservoir), as provided by section 16 of the Metropolitan Water Act, and this amount is included in the cost of Sudbury Reservoir and the protection of Sudbury supply.

MAINTENANCE AND OPERATION.	For the Year ending December 31, 1901.		From Beginning of Work, and ending December 31, 1901.	
Administration,	. . .	$7,933 57		$31,810 81
General supervision,	. . .	4,335 90		10,487 57
Taxes and other expenses,	. . .	26,378 87		47,480 14
Wachusett Reservoir Department: —				
Sanitary inspection,	$39 44		$39 44	
Buildings,	569 99		569 99	
Reservoir,	331 17		331 17	
		940 60		940 60
Wachusett Dam and Aqueduct Department: —				
General superintendence,	$1,653 55		$6,861 43	
Dam and aqueduct,	7,163 18		28,077 28	
Clinton sewerage system: —				
Pumping station,	2,238 18		5,195 55	
Sewers,	2,499 26		4,795 86	
Sanitary inspection,	394 20		1,269 84	
		13,948 37		46,199 46
Sudbury Department: —				
General superintendence,	$6,361 19		$25,214 73	
Superintendence, Framingham office,	6,757 22		23,175 39	
Sudbury Reservoir,	8,274 66		29,462 55	
Ashland Reservoir,	1,903 08		6,602 50	
Hopkinton Reservoir,	2,081 91		9,186 67	
Whitehall Reservoir,	242 21		1,413 47	
Framingham Reservoirs 1, 2 and 3,	5,296 73		19,725 38	
Lake Cochituate,	2,731 75		11,747 84	
Marlborough Brook filters,	3,354 66		6,635 23	
Pegan filters,	2,676 04		11,340 45	
Sudbury and Cochituate watersheds,	611 02		1,731 72	
Sanitary inspection,	2,308 97		9,673 45	
Sudbury and Cochituate Aqueducts,	18,342 15		70,251 90	
Chestnut Hill Reservoir,	13,169 23		43,316 87	
Biological laboratory,	3,177 66		13,867 40	
		77,288 48		283,345 55
Distribution Department: —				
Superintendence,	$12,465 87		$27,351 91	
Arlington pumping station, pumping service,	3,371 03		6,737 74	
Chestnut Hill high-service pumping station, pumping service,	40,611 50		175,774 31	
Chestnut Hill low-service pumping station, pumping service,	39,540 80		59,069 17	
Spot Pond pumping station, pumping service,	13,012 55		26,704 13	
West Roxbury pumping station, pumping service,	9,552 74		19,097 13	
Temporary pumping stations,	731 25		52,979 06	
Arlington standpipe,	119 71		393 93	
Fells Reservoir,	1,544 49		2,907 25	
Mystic Lake, conduit and pumping station,	2,750 64		14,310 11	
Mystic Reservoir,	1,474 71		9,086 20	
Amounts carried forward,	$125,175 29	$130,825 79	$394,410 94	$420,264 13

MAINTENANCE AND OPERATION.	For the Year ending December 31, 1901.		From Beginning of Work, and ending December 31, 1901.	
Amounts brought forward,	$125,175 29	$130,825 79	$394,410 94	$420,264 13
Distribution Department — *Con.*				
Forbes Hill Reservoir,	158 04		158 04	
Spot Pond,	4,191 91		9,047 59	
Waban Hill Reservoir,	2,549 80		3,451 02	
Pipe lines: —				
Low service,	18,883 21		82,489 71	
Northern high service,	4,378 94		17,543 12	
Southern high service,	3,882 11		10,862 15	
Buildings at Chestnut Hill,	2,038 26		4,749 01	
Chestnut Hill Pipe Yard,	1,482 76		1,482 76	
Glenwood Pipe Yard and buildings,	5,608 50		10,966 82	
Stables,	6,075 49		15,773 44	
Waste prevention,	90 14	174,009 45	90 14	551,024 74
Total for maintaining and operating works,	. . .	$304,835 24		$971,288 87

(3) DETAILED FINANCIAL STATEMENT.

The Board herewith presents, in accordance with the Metropolitan Water Act, an abstract of the expenditures and disbursements, receipts, assets and liabilities for the year 1901.

(*a*) *Expenditures and Disbursements.*

The total amount of the expenditures and disbursements on account of construction and acquisition of works for the year beginning January 1, 1901, and ending December 31, 1901, is $9,404,915.19; and the total amount from the time of the organization of the Board, July 19, 1895, to December 31, 1901, is $29,432,332.03.

For maintenance and operation the expenditures for the year have been $304,835.24, and from the beginning of the work $971,288.87.

The salaries of the commissioners, and other expenses of administration, have been apportioned to the construction of the works and to the maintenance and operation of the same, and appear under each of those headings.

The following is a division of the expenditures according to their general character: —

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1901.		From Beginning of Work, and ending December 31, 1901.	
I. CONSTRUCTION OF WORKS, AND ACQUISITION BY PURCHASE OR TAKING.				
Administration.				
Commissioners,	$9,300 00		$78,310 27	
Secretary and auditor,	4,289 44		33,320 90	
Clerks and stenographers,	6,296 45		30,456 10	
Legal services,	-		2,859 00	
Travelling,	534 27		1,999 15	
Stationery and printing,	825 84		5,469 66	
Postage, express and telegrams,	323 19		1,669 15	
Furniture and fixtures,	441 94		3,793 75	
Alterations and repairs of buildings,	2,830 89		5,672 03	
Telephone, lighting, heating, water and care of building,	1,156 96		6,566 79	
Rent and taxes, main office,	975 20		1,382 00	
Miscellaneous expenses,	664 20	$27,640 38	3,173 85	$174,672 65
Engineering.				
Chief engineer and department engineers,	$22,275 35		$182,247 20	
Principal assistant engineers,	15,510 24		95,524 88	
Engineering assistants,	98,985 40		668,974 11	
Consulting engineers,	1,000 00		23,187 07	
Inspectors,	26,291 56		162,760 82	
Architects,	1,656 78		25,870 47	
Railroad and street car travel,	2,185 50		20,970 54	
Wagon hire,	5,302 10		25,771 21	
Stationery and printing,	2,510 72		18,876 90	
Postage, express and telegrams,	883 68		5,583 95	
Engineering and drafting instruments and tools,	2,183 24		18,228 52	
Engineering and drafting supplies,	2,281 35		19,592 16	
Books, maps and photographic supplies,	520 67		4,834 84	
Furniture and fixtures,	1,569 60		14,240 58	
Alterations and repairs of building, — main office,	8,883 61		12,725 56	
Alterations and repairs of building, — sub-offices,	1,506 48		2,601 64	
Telephone, lighting, heating, water and care of building, — main office,	3,071 77		11,126 66	
Telephone, lighting, heating, water and care of building, — sub-offices,	1,708 93		10,817 19	
Rent and taxes, — main office,	2,976 00		3,874 35	
Rent of sub-offices and other buildings,	529 50		3,153 74	
Field offices and sheds,	247 65		1,067 70	
Clinton office building,	-		9,866 87	
Unclassified supplies,	850 42		5,756 72	
Miscellaneous expenses,	783 75		7,304 41	
Reimbursement, city of Boston,	-	203,664 35	69,918 69	1,374,826 89
Amounts carried forward,	. . .	$231,304 73		$1,549,499 54

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1901.		From Beginning of Work, and ending December 31, 1901.	
Amounts brought forward,	. . .	$231,304 73		$1,549,499 54
Construction.				
Preliminary work (borings, test pits and other investigations): —				
Advertising,	$839 71		$5,365 40	
Labor,	15,774 70		96,898 32	
Professional services, medical services, analyses, etc.,	61 50		687 83	
Travelling,	11 90		1,644 78	
Rent,	-		37 00	
Water rates,	-		2,077 30	
Freight and express,	41 32		459 53	
Jobbing and repairing,	54 03		476 20	
Tools, machinery, appliances and hardware supplies,	449 63		15,596 74	
Casting, ironwork and metals,	39 26		175 57	
Iron pipe and valves,	156 32		3,230 03	
Blasting supplies,	4 56		41 29	
Paint and coating,	1 44		139 98	
Fuel, oil and waste,	435 87		983 80	
Lumber and field buildings,	1,689 48		6,478 74	
Drain pipe,	-		40 80	
Brick, cement and stone,	14 62		237 81	
Sand, gravel and filling,	74 40		269 45	
Municipal and corporation work,	-		44 07	
Unclassified supplies,	127 29		1,209 89	
Miscellaneous expenses,	10 00		249 69	
Reimbursement, city of Boston,	-	19,786 03	55,404 63	191,748 85
Contracts, Wachusett Reservoir: —				
Contracts completed and final payments made prior to January 1, 1901,	-		$340,071.53	
Moulton & O'Mahoney, excavating soil and refilling at North Dike, Sect. 4,	$6,140 47		157,130 37	
Nawn & Brock, excavating soil, Sect. 6, and building easterly portion of North Dike,	321,356 01		677,854 36	
Busch Bros., excavating soil, Sect. 6, and building road, West Boylston and Boylston, — $600 due, deducted from estimate September 5, 1900,	-		34,560 63	
Long & Little, excavating soil, Sect. 7, and building part of North Dike,	89,960 47		151,042 36	
Newell & Snowling Construction Co., excavating soil from Sect. 8, and completing westerly portion of North Dike,	32,443 72		32,443 72	
Asa Goddard, surfacing Boylston Street, Sect. 2,	60 00		11,428 95	
Amounts carried forward,	$449,960 67	$251,090 76	$1,404,531 92	$1,741,248 39

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1901.		From Beginning of Work, and ending December 31, 1901.	
Amounts brought forward, ...	$449,960 67	$251,090 76	$1,404,531 92	$1,741,248 39
Construction — Con.				
Contracts, Wachusett Reservoir — *Con.*				
Fred E. Ellis, surfacing Sect. 2, Shrewsbury Road, ...	200 00		10,654 35	
McArthur Bros., Wachusett Dam, . .	157,370 96	607,531 63	159,921 64	1,575,107 91
Contracts, Wachusett Aqueduct: —				
Contracts completed and final payments made prior to January 1, 1901, . . .	-		$1,197,506 07	
Silvio Casparis, covered masonry, Sect. 5, .	$600 00		101,179 99	
Silvio Casparis, covered masonry, Sect. 6, .	469 00	1,069 00	148,522 49	1,447,208 55
Contracts, Sudbury Reservoir: —				
Contracts completed and final payments made prior to January 1, 1901, . . .	-		$1,963,732 76	
Auguste Saucier, filter-beds, ...	. . .	3,227 50	42,384 83	2,006,117 59
Contracts, improving Lake Cochituate: —				
Long & Little, excavation from Snake Brook Meadow, ...	. . .	10,236 80		10,236 80
Town of Framingham, low-level sewer, protection Cochituate supply, ...	. . .	2,250 00		9,000 00
Contracts, Rosemary siphon: —				
Contracts completed and final payments made prior to January 1, 1901, . . .	-			5,916 96
Contracts, pipe line, Dam No. 3 to Dam No. 1: —				
Contracts completed and final payments made prior to January 1, 1901, . . .	-			17,240 22
Contracts, Clinton sewerage system: —				
Contracts completed and final payments made prior to January 1, 1901, . . .	-			66,878 22
Contracts, Weston Aqueduct: —				
Shanahan, Casparis & Co., . . Sect. 2,	$39,568 22		$39,568 22	
Shanahan, Casparis & Co., . . Sect. 3,	23,206 62		23,206 62	
Patrick McGovern, ... Sect. 4,	43,468 46		43,468 46	
Bruno, Salomone & Petitti, . . Sect. 5,	43,758 04		43,758 04	
Shanahan, Casparis & Co., . . Sect. 6,	20,489 84		20,489 84	
Winston & Co., . . Sects. 8 and 10,	9,648 26		9,648 26	
Shanahan, Casparis & Co., . . Sect. 12,	27,384 71		27,384 71	
Columbus Construction Co., . . Sect. 13,	36,017 65		36,017 65	
Winston & Co., ... Sect. 15,	3,326 58	246,858 38	3,326 58	246,858 38
Contracts, Distribution System: —				
Contracts completed and final payments made prior to January 1, 1901, . . .	-		$2,950,044 58	
E. W. Everson & Co., pipe laying, Sect. 19, ...	$200 00		37,042 54	
C. H. Eglee Co., pipe laying, Sect. 29, . .	20,450 12		20,450 12	
The Atlantic Works, sluice gates, . .	48 00		14,438 00	
Amounts carried forward, ...	$20,698 12	$1,122,264 07	$3,021,975 19	$7,125,813 02

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1901.		From Beginning of Work, and ending December 31, 1901.	
Amounts brought forward,	$20,698 12	$1,122,264 07	$3,021,975 19	$7,125,813 02
Construction — Con.				
Contracts, Distribution System — *Con.*				
Beckwith & Quackenbush, reservoir and foundation for standpipe at Forbes Hill,	18,903 12		31,421 17	
Walsh's Holyoke Steam Boiler Works, standpipe at Forbes Hill,	768 47		4,529 72	
James E. McCoy, masonry tower, Forbes Hill,	11,774 05		11,774 05	
McNeil Bros., high-service pumping station and gate-house, — $1,500 due, deducted from final estimate May 22, 1901,	6,278 98		120,681 08	
Holly Manufacturing Co., high-service pumping engine, Spot Pond,	31,264 38		78,139 38	
Norcross Bros., Chestnut Hill low-service pumping station,	8,104 16		200,549 82	
Holly Manufacturing Co., Chestnut Hill low-service pumping engine,	35,234 62		151,259 62	
John S. Jacobs & Son, southern gate-house, Chestnut Hill Reservoir,	4,374 00		9,974 00	
Norcross Bros., connection chamber Chestnut Hill,	1,552 00		1,552 00	
C. H. Eglee Co., Bear Hill Reservoir,	16,562 18		16,562 18	
		155,504 08	$3,648,418 21	
Deduct value of pipes, valves, etc., included in above list, transferred to maintenance account December 31, 1900, and shown on page 39,	-		3,139 77	
				3,645,278 44
Additional work: —				
Labor,	$17,068 06		$453,201 99	
Professional services, medical services, analyses, etc.,	443 95		1,450 99	
Travelling,	54 08		926 65	
Rent,	360 00		2,957 37	
Water rates,	712 13		1,318 98	
Freight and express,	494 20		8,298 74	
Jobbing and repairing,	352 48		6,913 89	
Tools, machinery, appliances and hardware supplies,	5,291 52		62,552 44	
Electrical supplies,	2,088 49		4,771 50	
Castings, ironwork and metals,	4,422 71		42,904 71	
Iron pipe and valves,	4,970 92		42,806 48	
Blasting supplies,	-		859 41	
Paint and coating,	115 84		3,601 18	
Fuel, oil and waste,	110 14		5,670 34	
Lumber and field buildings,	768 12		70,827 10	
Drain pipe,	314 33		4,488 17	
Brick, cement and stone,	1,045 00		12,785 12	
Amounts carried forward,	$38,621 47	$1,277,768 15	$726,335 06	$10,771,091 46

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1901.		From Beginning of Work, and ending December 31, 1901.	
Amounts brought forward,	$38,621 47	$1,277,768 15	$726,335 06	$10,771,091 46
Construction — Con.				
Additional work — *Con.*				
Sand, gravel and filling,	550 43		4,683 37	
Municipal and corporation work,	487 50		64,753 87	
Police service,	22,584 46		123,458 62	
Sanitary inspection,	918 00		6,141 61	
Judgments,	2,153 36		7,749 49	
Unclassified supplies,	973 52		7,976 74	
Miscellaneous expenses,	6,250 91		14,552 42	
Reimbursement city of Boston,	-	72,539 65	21,765 87	977,417 05
Legal and expert: —				
Legal services,	-		$4,618 82	
Expert services,	-		475 87	
Court expenses,	$7 00		360 31	
Miscellaneous expenses,	-	7 00	33 35	5,488 35
Real Estate.				
Legal and expert: —				
Legal services,	-		$4,736 31	
Conveyancer and assistants,	$8,094 26		76,973 66	
Experts,	1,520 18		16,895 58	
Appraisers,	1,969 00		15,131 34	
Court expenses,	393 37		2,294 52	
Counsel expenses,	-		43 25	
Conveyancing supplies,	110 33		2,891 00	
Conveyancing expenses,	592 32		4,531 96	
Miscellaneous expenses,	46 25		917 45	
Reimbursement, city of Boston,	-		15,021 25	
Settlements, made by Board,	140,882 28		2,891,757 01	
Settlements, reimbursement, city of Boston,	-		531,606 00	
Judgments,	11,315 57		32,753 04	
Taxes and tax equivalents,	2,029 49		70,128 80	
Care and disposal,	15,208 11	182,161 16	38,056 75	3,703,737 92
Damages to Real Estate not taken, to Business, and on Account of Loss of Wages.				
Legal and expert: —				
Legal services,	-		$1,130 67	
Court expenses,	$1,453 86		1,453 86	
Settlements,	61,560 50	63,014 36	173,958 41	176,542 94
Claims on Account of Diversion of Water.				
Legal and expert: —				
Legal services,	-		$3,774 98	
Expert services,	$1,496 47		13,230 64	
Court expenses,	2,343 79		2,343 79	
Miscellaneous expenses,	875 81		1,173 91	
Settlements,	35,000 00	39,716 07	917,350 00	937,873 32
Amounts carried forward,		$1,635,206 39		$16,572,151 04

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1901.		From Beginning of Work, and ending December 31, 1901.	
Amounts brought forward,	. . .	$1,635,206 39		$16,572,151 04
Purchase of Existing Water Works.				
Legal and expert: —				
Legal services,	-		$1,878 89	
Expert services,	$760 00		2,650 65	
Miscellaneous expenses,	-		952 94	
Settlements and judgments,	7,768,948 80	7,769,708 80	12,854,698 51	12,860,180 99
Total amount of construction expenditures,		$9,404,915 19		$29,432,332 03
II. MAINTENANCE AND OPERATION OF WORKS.				
Administration: —				
Commissioners,	$1,200 00		$8,400 00	
Secretary, auditor and assistants,	3,678 07		16,994 06	
Postage, printing, stationery and other supplies,	676 36		1,811 48	
Travelling,	223 96		606 92	
Telephone, heating, lighting and care of building,	486 29		1,901 49	
Alterations and repairs of building,	1,380 62		1,450 62	
Rent and taxes, office building,	166 00		295 66	
Miscellaneous expenses,	127 77		350 64	
Supervision and general superintendence: —				
Chief engineer and department engineers,	8,524 65		27,188 82	
Engineering and clerical assistants,	7,907 96		26,581 10	
Postage, printing, stationery and office supplies,	1,374 71		3,089 49	
Telephone, heating, lighting and care of offices,	1,309 21		4,069 05	
Travelling and incidental expenses,	451 00		1,996 12	
Alterations and repairs of buildings,	4,186 83		5,259 85	
Rent and taxes, main office,	495 00		719 59	
Miscellaneous expenses,	572 15		1,062 12	
Pumping service: —				
Labor,	50,500 85		138,671 55	
Fuel,	44,057 91		123,494 50	
Oil, waste and packing,	1,987 88		5,302 32	
Repairs and renewals,	5,839 43		16,745 31	
Small supplies and expenses,	3,519 05		8,989 31	
Pumping by municipalities,	-		45,273 80	
Rent, West Roxbury pumping station,	920 00		1,840 00	
Superintendents and assistant superintendents,	3,548 43		11,956 76	
Engineering assistants,	7,295 17		27,942 58	
Laboratory force,	2,354 61		10,315 98	
Sanitary inspectors,	2,414 44		9,641 12	
Recording and scientific instruments and supplies,	529 82		2,159 00	
Labor and teaming,	85,224 73		278,703 19	
Tools, machinery and appliances,	1,451 40		7,167 57	
Lumber and hardware supplies,	2,371 12		8,165 67	
Jobbing and repairing,	1,626 69		7,669 17	
Amounts carried forward,	$246,341 61		$805,764 28	

GENERAL CHARACTER OF EXPENDITURES.	For the Year ending December 31, 1901.		From Beginning of Work, and ending December 31, 1901.	
Amounts brought forward,	$246,841 61		$805,764 28	
MAINTENANCE, ETC. — *Con.*				
Travelling,	3,219 12		9,768 30	
Horses, vehicles and stable expenses,	3,387 71		13,326 02	
Fuel, lighting and telephone,	2,976 38		10,076 59	
Municipal and corporation work,	288 12		3,838 79	
Alterations and repairs of buildings,	-		402 97	
Settlements of claims,	-		1,000 00	
Unclassified supplies,	5,191 62		15,600 46	
Miscellaneous expenses,	1,402 07		4,826 96	
Conveyancer and assistants,	50 85		352 85	
Taxes and tax equivalents,	26,824 90		47,124 17	
Contracts and agreements,	12,870 09		53,784 94	
Contracts for pipes, valves, etc., bought from construction work since January 1, 1901,	2,782 77		2,782 77	
Contracts for pipes, valves, etc., originally charged to construction, transferred to maintenance previous to January 1, 1901 (included in list, pages 35–36),	-		3,139 77	
Total expenditures for maintenance and operation,		$304,835 24		$971,288 87

(*b*) *Receipts.*

The total amount of receipts from rents, sales of property, etc., for the year beginning January 1, 1901, and ending December 31, 1901, is $76,330.19; and the total amount from the time of the organization of the Board, July 19, 1895, to December 31, 1901, is $214,716.56. The general character of these receipts is as follows: —

GENERAL CHARACTER OF RECEIPTS.	For the Year ending December 31, 1901.		From Beginning of Work, and ending December 31, 1901.	
For distribution back to District: —				
District entrance fees,	$30,000 00		$65,005 00	
Supplying water outside of District,	2,759 80		25,405 64	
Water furnished to water companies,	12,506 69	$45,266 49	17,878 27	$108,288 91
To the credit of the loan fund: —				
Real estate and buildings,	$4,377 09		$9,870 00	
Labor, tools and supplies,	5,313 85	9,690 94	21,237 58	31,107 58
To the credit of the sinking fund: —				
Forfeiture for contracts awarded but not executed,	-		$500 00	
Rents,	$16,241 41		59,813 04	
Land products,	5,080 76		14,682 04	
Unclassified receipts,	50 59	21,372 76	324 99	75,320 07
Total receipts,	. . .	$76,330 19		$214,716 56

The foregoing receipts have been credited to the various objects or works, as follows: —

RECEIPTS FROM DIFFERENT WORKS.	For the Year ending December 31, 1901.		From Beginning of Work, and ending December 31, 1901.	
Distribution back to District: —				
Admission into Metropolitan Water District (Nahant, Quincy and Arlington),	$30,000 00		$65,005 00	
Supplying water to towns outside of Water District (Swampscott and Lexington),	2,759 80		25,405 64	
Water furnished to water companies,	12,506 69	$45,266 49	17,878 27	$108,288 91
Construction and acquisition of works: —				
Administration,	$0 75		$0 75	
Wachusett Dam,	397 00		452 09	
Wachusett Reservoir,	18,772 87		67,168 36	
Wachusett Aqueduct,	233 83		504 95	
Weston Aqueduct,	1,120 51		1,120 51	
Sudbury Reservoir and watershed,	727 20		7,249 20	
Distribution system,	7,052 73		16,476 05	
Diversion of water, Clinton sewerage system,	10 00		656 91	
Purchase of existing water works,	795 87	29,110 76	5,288 12	98,916 94
Maintenance and operation of works: —				
Wachusett Aqueduct,	$435 00		$1,582 11	
Sudbury system,	906 66		4,023 28	
Distribution system,	118 90		1,216 88	
Clinton sewerage system,	492 38	1,952 94	688 44	7,510 71
Total receipts,	. . .	$76,330 19		$214,716 56

(c) *Assets.*

The following is an abstract of the assets: —

Office furniture, fixtures and supplies: —

46 book cases; 46 plan cases; 87 miscellaneous cases and cabinets; 382 chairs; 133 desks; 22 letter-copying presses; 7 numbering machines; railroad tickets (value), $2,116.04; 534 reference books; 168 stools; 66 coal stoves; 93 tables (office); 45 tables (drafting); 17 telephones; 20 typewriters; stamped envelopes (value), $970.67.

Engineering and scientific instruments and supplies: —

1 biological laboratory outfit; 1 chemical laboratory outfit; 106 drawing boards; 8 calculating instruments; 6 cement-testing machines; 3 current meters; 5 electrical instruments; 28 engineers' levels; 3 pantographs; 1 photographic outfit; 24 planimeters; 185 levelling, measuring and sight rods; 211 rubber boots, pair; 266 scales; 4 section liners; 74 straight-edges; 225 tapes; 4 transverse testing machines; 28 transits.

Police supplies: —

23 belts; 9 cells; 33 clubs; 12 beds; 31 pair handcuffs; 7 revolvers; 28 pair twisters; 2 stretchers.

Horses, vehicles, field machinery, etc.: —

19 horses; 9 carriages; 10 carts; 6 sleds; 14 sleighs; 17 wagons; 3 harrows; 3 mowing machines; 12 ploughs; 3 horse rakes; 4 road rollers; 2 road scrapers; 2 tedders; 51 blankets; 32 harnesses; 26 robes; 283 bush hooks, bill hooks, scythes, etc.; 6 hand carts; 43 border knives, hedge trimmers, etc.; 11 lawn mowers.

Machinery, tools and other appliances and supplies: —

5 adzes; 9 anchors; 12 anvils; 209 axes and hatchets; 132 barrows; 210 bars, crow and others; 2 blasting batteries; 203 blocks, all kinds; 2 blowers; 17 boats, row; 32 boilers; 2 diamond drills; 74$\frac{1}{32}$K. diamonds for same; 356 chisels; 13 carts and cars; 29 chain hoists; 1 concrete mixer; 14 derricks; 7 dredges, scows, etc.; 24 drilling machines; 5 dynamos; 26 engines; 7 forges; 6 furnaces, melting; 92 gages; 31 grindstones; 171 hoes, all kinds; 152 forks; 395 hammers; 1 heater; 43 hoisting buckets; 5,231 feet hose, all sizes; 138 ice tools; 8 indicators; 8 injectors and inspirators; 52 jacks; 1,309 feet ladders; 4 lathes; 249.5 M feet B. M. lumber; 143 mattocks; 17 mauls; 18 meters, pressure, etc.; 2 motors; 33 oil cabinets and tanks; 3 pile drivers; 21 pipe cutters; 35 die plates, stocks, etc.; 1 pipe-tapping machine; 368 picks; 1 planer; 9 pumping engines; 50 steam pumps; 13 centrifugal pumps; 16 diaphragm pumps; 19 miscellaneous pumps; 231 rakes; 103 rammers; 2 rock drills; 137 saws; 36 scales, yard, platform, etc.; 44 settees, Chestnut Hill grounds; 914 shovels, scoops, spades, etc.; 1 steam shovel; 1 stone crusher; 89 temporary buildings and structures; 130 tongs; 47 tool and coal boxes, etc.; 29 trench and other braces; 4 trucks; 39 vises; 3 winches; 833 wrenches; 10,085 feet wrought-iron pipe, all sizes; 137 tons cast-iron pipe, miscellaneous lots; $70,703.73 cast-iron pipes, special castings, valves, man-hole covers, etc, at pipe yards (estimated value).

Real estate connected with works not completed: —

Real estate in the site of the proposed Wachusett Reservoir and margins; outlying property in Clinton, Boylston, West Boylston and Sterling; land for Weston Aqueduct and Reservoir; and for the partially completed Bear Hill Reservoir, Stoneham.

Completed works, including real estate and buildings connected therewith: —

Wachusett Aqueduct, Sudbury Aqueduct, Cochituate Aqueduct; Whitehall Reservoir, Hopkinton Reservoir, Ashland Reservoir, Framingham Reservoirs Nos. 1, 2 and 3, Sudbury Reservoir, Lake Cochituate, Chestnut Hill Reservoir, Waban Hill Reservoir, Fells Reservoir, Mystic Lake conduit and pumping station (not used), Mystic Reservoir; Forbes Hill Reservoir and standpipe; Arlington standpipe; Chestnut Hill high-service pumping station, Chestnut Hill low-service pumping station, Spot Pond and Spot Pond pumping station, temporary pumping station, Arlington; sewerage system and pumping station, Clinton; 72 miles of pipe line in distribution system; Mystic yard and buildings, Glenwood pipe yard and buildings, Chestnut Hill pipe yard and buildings; Clinton office and grounds.

(*d*) *Liabilities.*

There are liabilities as follows: —

Unpaid bills,	**$15,205 00***
Due on monthly pay rolls,	**5,270 00**
	$20,475 00

Amounts reserved on Monthly Estimates, not due until Completion of Contracts or until Claims are settled.

NAME.	Work.	Amount.
Nawn & Brock,	**Wachusett Reservoir, Sect. 6,**	**$50,000 00**
McNeil Bros.,	**High-service pumping station, Items 8 and 9,**	**1,500 00**
Busch Bros.,	**Building road, Wachusett Reservoir,**	**600 00**
Long & Little,	**Wachusett Reservoir, Sect. 7,**	**23,361 62**
Beckwith & Quackenbush,	**Reservoir and foundation for standpipe,**	**5,544 91**
McArthur Bros.,	**Wachusett Dam,**	**28,221 47**
James E. McCoy,	**Masonry water tower,**	**2,077 77**
Shanahan, Casparis & Co.,	**Weston Aqueduct, Sect. 2,**	**6,381 74**
Shanahan, Casparis & Co.,	**Weston Aqueduct, Sect. 3,**	**3,865 88**
Patrick McGovern,	**Weston Aqueduct, Sect. 4,**	**3,981 79**
Bruno, Salomone & Petitti,	**Weston Aqueduct, Sect. 5,**	**7,722 01**
Shanahan, Casparis & Co.,	**Weston Aqueduct, Sect. 6,**	**3,368 80**
Winston & Co.,	**Weston Aqueduct, Sects. 8 and 10,**	**1,702 64**
Shanahan, Casparis & Co.,	**Weston Aqueduct, Sect. 12,**	**4,550 24**
Columbus Construction Co.,	**Weston Aqueduct, Sect. 13,**	**6,356 06**
Winston & Co.,	**Weston Aqueduct, Sect. 15,**	**587 04**
C. H. Eglee & Co.,	**Bear Hill Reservoir,**	**1,158 03**
Newell & Snowling Construction Co.,	**Wachusett Reservoir, Sect. 8,**	**5,725 36**
Long & Little,	**Excavation from Snake Brook Meadow,**	**1,321 20**
		$158,026 56

Amounts have been agreed upon in the following cases, but the deeds have not passed: —

Bruno St. Onge, $4,000; Lizzie W. Thompson, $800; Annie Pendergast, $2,080; Evelyn V. Nolte, $250; heirs of Deborah Ware, $9,283.26; Luther Frank Upham, $75; John A. Frye, $900; Alice C. Davis *et als.*, $75; S. M. & C. B. Cutting,

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*** Miscellaneous current bills of 1901, including those coming in from time to time after January 1, 1902, have since been paid.**

$4,100; Helen M. Bennett *et als.*, $1,400; A. J. Scarlett *et al.*, $1,000; John Toomey, $12,000; Asia S. Jefts, $1,425; Lucretia B. Lawrence, $8,700; Mary F. Cutting, $4,750; Henry Brown *et als.*, $3,500; E. Lewis Moore, $150; R. E. & W. C. Forbes, $75.

On the claims of the following it is impossible to state the amounts due for land damages and water rights, as suits are now pending in the courts for the determination of the same: —

Patrick T. Moran, Harriet Wilder, Maria A. Haskell, Timothy John Fahy, Chloe Ann Ballou, William H. Buck, estate of Henrietta M. Johnson, Charles L. Johnson, Israel G. Howe, Charles B. Sawin, W. O. Johnson, Jeremiah Potter, J. R. Stott, Horace H. Lowe, Bigelow Carpet Company, Elijah Bemis, Charles E. Nichols, Nellie E. Burke, J. M. Sears, city of Malden, balance city of Medford, city of Melrose, Henry Jackson, Antoine Snow, Sarah E. Kirby, Edward A. Cowee, Joseph Toombs, Cyrus Colt, heirs of Hanson Chase, Boston & Maine Railroad, American Telephone and Telegraph Company, John N. Flagg, George L. Hyde, Edward A. Harper, Thomas Mackesy, Delina Mallett, Independent Order of Odd Fellows, John F. O'Brien, Boston & Albany Railroad Company, Emory A. Bacon, Louis Bond, Ralph H. Hosmer *et als.*, Frances A. Wilder *et al.*, Frances H. Chase, *administratrix*, Nashua River Paper Company, George L. Redding, Michael O'Malley, James Dorr, Charles U. Cotting *et als.*, Hannah McAndrew, Margaret E. Sargent, Framingham Water Company, Charles W. Felt, Johanna T. Dunn, Ida E. Wadsworth.

V. SEWERAGE WORKS — CONSTRUCTION.

The Metropolitan Sewerage Works, both in construction and maintenance, are now divided into two general systems, — the North Metropolitan System and the South Metropolitan System.

(1) NORTH METROPOLITAN SYSTEM.

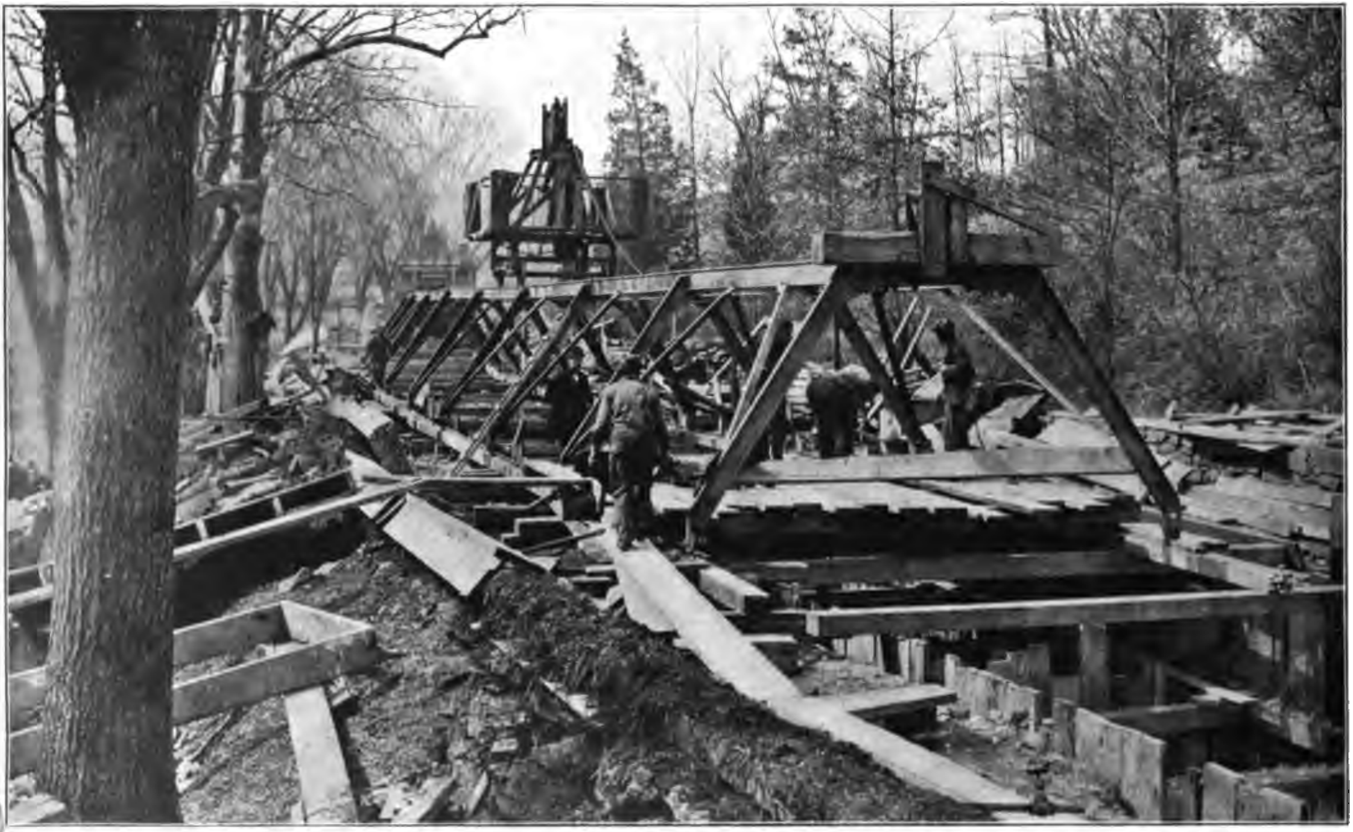
The North Metropolitan System provides for a district which lies wholly north of the Charles River, and has an area of 85 square miles, including the cities and towns of Arlington, Belmont, Cambridge, Chelsea, Everett, Malden, Medford, Melrose, Somerville, Stoneham, Wakefield, Winchester, Winthrop, Woburn, a part of the town of Lexington, and the parts of the city of Boston known as East Boston and Charlestown. These localities are situated in part in the Mystic River valley and in part in the Charles River valley. The district has a population of nearly 450,000, of whom about 325,000 contribute sewage to the system. The Metropolitan sewers constructed in the district are about 55 miles in length. Within the District are operated the Deer Island, East Boston, Charlestown and Alewife Brook (Somerville) pumping stations. The North Metropolitan System, as now contemplated, has been substantially completed.

But little construction was done during the fifteen months beginning with October 1, 1900, and ending with December 31, 1901. A sewer of the length of 1.58 miles was constructed, under the authority of chapter 184 of the Acts of the year 1900, in Chelsea, in order to provide additional outlets for areas in Chelsea and Everett. A length of 3.04 miles of sewer was constructed in accordance with chapter 172 of the same year, which authorized the Board to construct a main trunk sewer through the cities of Malden and Melrose to the line of the town of Wakefield, in order to provide for the part of that town which had not previously been a portion of the Metropolitan area. Considerable difficulty was experienced in the construction of a portion of this sewer, but the work was successfully accomplished in the month of December.

(2) SOUTH METROPOLITAN SYSTEM.

The South Metropolitan System has an area of 102 square miles, and embraces the cities and towns of Brookline, Hyde Park, Milton, Newton and Quincy, a part of the town of Dedham, and the Brighton district and portions of the Back Bay, Dorchester, Roxbury and West Roxbury districts in the city of Boston, all situated on the south side of the Charles River, together with the city of Waltham and the town of Watertown situated on the north side of that river. These localities are partly in the Charles River valley and partly in the Neponset River valley. The South Metropolitan District has a population of about 280,000, of whom about 110,000, as is estimated, now contribute sewage to the system. The Metropolitan sewers already constructed have a length of 27 miles, and there is one pumping station, that at Quincy. This system is but partially completed.

The provisions of chapter 424 of the Acts of the year 1899 authorized the construction of the high-level sewer, so called, and



HIGH LEVEL SEWER — Construction with Trench Machine in South Street, passing Hemlock Hill.

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united the systems formerly known as the Charles River Valley System and the Neponset River Valley System, with other territory, as the South Metropolitan System.

The sewers embraced in the Charles River Valley and Neponset River Valley systems had been constructed prior to the passage of the Act, and it was provided that the sewage received from these two systems and from the additional territory in the city of Quincy, and in the Roxbury, West Roxbury and Dorchester portions of the city of Boston should be conveyed to an outlet into the sea.

The high-level sewer begins at its connection with the old Charles River valley sewer near the proposed Ward Street pumping station, at the foot of the northerly side of Parker Hill in Roxbury, and extends in a southerly direction under Parker Hill, through Jamaica Plain, past the Arnold Arboretum, and, turning thence in a general southeasterly direction, continues through the northeasterly part of Hyde Park, to a connection with the existing Neponset valley sewer, thence passes under the Neponset River, and extends in an easterly direction through the northerly part of Milton to the central part of Quincy, and thence, passing near the Mount Wollaston Cemetery, through Hough's Neck to Nut Island, from which cast-iron outfall pipes, about a mile in length, are to be laid in the bed of the harbor.

The entire length of the high-level sewer will be about 16.81 miles, and the work, for purposes of construction, is divided into 36 contract sections. Previous to October 1, 1900, contracts had been made for the construction of 9 sections, involving a length of about 5.03 miles. The work on a portion of these sections was far advanced, but none of them had been completed at that date. Contracts have since been made for 17 of the remaining sections. The sections remaining to be arranged for are those at Hough's Neck and Nut Island; a section in Milton on the proposed extension of Brook Road or boulevard; the crossing of the Neponset River; the completion of the crossing of Stony Brook (now under construction by day labor); the filling in of special work omitted in Section 70, in West Roxbury; the construction and equipment of the Ward Street pumping station; the laying of two lines of force mains from the pumping station to the Parker Hill tunnel; and the building of a line of sewer to connect the high-level sewer with the existing Charles River Valley System.

The total amount of the contracts already made for the high-level sewer is, as estimated, $2,782,241.58, and the value of the work performed to December 31, 1901, is estimated to be $1,393,420. The appropriation made for this sewer was $4,600,000.

Of the total length of the sewer, 12.65 miles are expected to be constructed in open trench, and the remaining 4.16 miles in tunnel.

Of the 14.08 miles already contracted for, 7.24 miles have now been excavated to grade in trench or tunnel, leaving 6.84 miles at a less advanced stage of construction.

The trunk sewer is built in general in the horseshoe form, the vertical diameters varying from 12 feet 6 inches to 9 feet 2 inches, and the horizontal diameters approximating nine-tenths of the vertical.

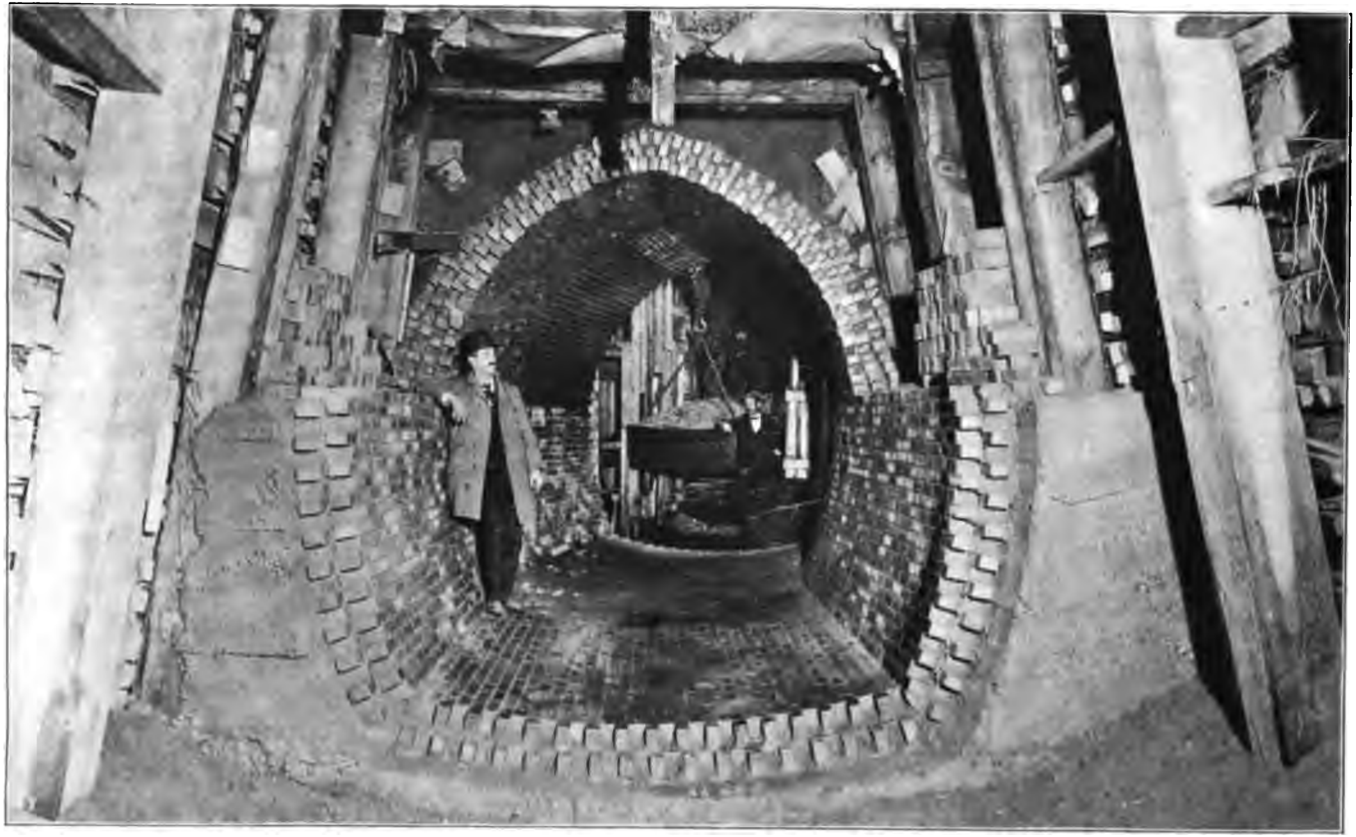
The latest date required for the completion of any contract for this sewer now made is April 1, 1903.

Chapter 204 of the Acts of the year 1901 required the Board to make an extension of the Metropolitan sewer from a branch in St. Joseph's Cemetery through lands in West Roxbury and Newton to the Brookline town line, a distance of 6,718 feet. The plan proposed for the extension was submitted, in accordance with the Act, to the State Board of Health, and was approved by that Board on September 5, 1901. A contract has been made for the construction of this sewer, and about a quarter of the work had been accomplished at the end of the year.

The sewerage construction work carried on during the year 1901 was greater than that in any preceding year since the establishment of the Sewerage Commission, and involved an expenditure, exclusive of maintenance, of upwards of $1,660,000.

(3) Quincy Pumping Station.

In accordance with the provisions of the Act establishing the South Metropolitan System, the pumping station of the city of Quincy was purchased by the Board and transferred to the Commonwealth on April 1, 1901. This station is located near the northerly limit of Merrymount Park. The pumping station contains two engines and other equipment, having a capacity for pumping respectively 3,000,000 gallons and 5,000,000 gallons per day. Included in the purchase of this station were 2¾ acres of land and a cast-iron force main from the station to its junction with the outfall sewer of the Boston main drainage system, a distance of about 3.40 miles.



HIGH LEVEL SEWER—CONSTRUCTION OF TUNNEL IN SAND, FOREST HILLS.

UNIV. OF MICH.

(4) Purchases and Takings of Land.

During the period beginning October 1, 1900, and ending on March 20, 1901, the Metropolitan Sewerage Commission made 7 takings of lands and easements, 6 of which were for the purposes of the high-level sewer of the South Metropolitan System and 1 for the Wakefield extension of the North Metropolitan System. These takings embraced 20.82 acres in fee, and easements in 62.92 acres, of which 29.69 acres were in streets.

Since March 20, 1901, the Board has made 5 takings, all for the South Metropolitan System, 2 of which were for the high-level sewer, 2 for the Brookline extension and 1 of the lands and easements connected with the Quincy pumping station. By these takings 2.72 acres were acquired in fee, and easements in 31.60 acres, of which 16.33 acres were in streets.

The following is a list of the takings: —

List of Takings made by the Board of Metropolitan Sewerage Commissioners from October 1, 1900, to March 20, 1901.

LOCATION AND DESCRIPTION.	Former Owners.	Recorded.	Sections and Purpose of Taking.
		1900.	
Quincy (from Sea and Darrow streets to Greenleaf Street, land of trustees of Woodward Fund to land of heirs of Austin White). Area, 14 acres in fee; easements in 23.31 acres (estimated).	Mrs. J. Q. Adams *et al.*,	Nov. 8,	Sections 48, 49 and 50, High-level Sewer.
Nut Island. Area, 5 acres in fee, .	Heirs of Augusta B. French.	Nov. 8,	Section 44, High-level Sewer.
Milton and Quincy (from Adams Street, at middle line of Furnace Brook, Quincy, to land late of Samuel Babcock). Area, easements in 5.99 acres.	City of Quincy and town of Milton.	Nov. 22,	Sections 55 and 56, High-level Sewer.
Milton and Hyde Park (from Monponset Street, Hyde Park, through Brook Road to Pine Tree Brook, Milton). Area, easements in 7.37 acres (estimated).	Town of Milton *et al.*,	Nov. 22,	Sections 62, 63 and 64, High-level Sewer.
Malden, Melrose and Wakefield (from land of Alice C. Mann, Linden Avenue, Malden, through Malden and Melrose to a point 10 feet beyond the boundary line in Wakefield). Area, easements in 8.60 acres (estimated).	Mrs. Alice C. Mann *et al.*	Nov. 20,	Sections 58, 59 and 60, Wakefield Branch Extension (North Metropolitan System).
Quincy (from Hancock Street through highways and private ways to Greenleaf Street). Area, easements in 3.17 acres (estimated).	- -	Dec. 19,	Sections 50 and 51, High-level Sewer.
		1901.	
Quincy (from Sea Street through streets and private land to Nut Island. Area, 1.82 acres in fee; easements in 14.48 acres (estimated).	Martha Mears *et al.*, .	Jan. 18,	Sections 44, 45, 46 and 47, High-level Sewer.

The above acreage in which easements were taken includes 29.69 acres in public streets.

List of Takings for Metropolitan Sewerage Works from March 20, 1901, to December 31, 1901.

No.	LOCATION AND DESCRIPTION.	Former Owners.	Recorded.	Sections and Purpose of Taking.
1	Quincy (from pumping station to junction of force mains with Boston sewer). Area, 2.72+ acres in fee; easements in 14.71 acres.	City of Quincy *et al.*,	April 1,	24-inch force main and pumping station.
2	Quincy (from Greenleaf Street to Eaton's Pond). Area, easements in 6.44 acres.	Metropolitan Park Commissioners *et al.*	Oct. 2,	Sections 52, 53 and 54, High-level Sewer.
3	Milton (from Adams Street, near Squantum Street, to Canton Avenue, near Brook Road). Area, easements in 7.89 acres.	J. H. Brooks estate *et al.*	Oct. 2,	Sections 57, 58, 59 and 60, High-level Sewer.
4	West Roxbury (St. Joseph's Cemetery). Area, easements in 0.50 acre.	Holyhood Cemetery Association.	Oct. 9,	Section 30, Brookline Extension of Neponset Valley Sewer.
5	Newton (St. Joseph's Cemetery to Brookline). Area, easements in 2.06 acres.	Matilda B. Schworer *et al.*	Oct. 10,	Section 30, Brookline Extension of Neponset Valley Sewer.

The above acreage in which easements were taken includes 16.33 acres in public streets.

Since October 1, 1900, settlements have been effected on account of the takings made in the North Metropolitan District in 5 cases, involving a payment of $1,473.50; and in cases in the South Metropolitan District 52 settlements have been effected, under which payments have been made amounting to $172,501.96.

Summary of Land Settlements, October 1, 1900, to December 31, 1901.

LOCATION.	Area in Acres.	Number of Settlements.	Payments.
North Metropolitan District.			
Everett, ...	0.09	2	$200 00
Chelsea, ...	0.19	1	138 00
Melrose, ...	0.11	1	235 50
Malden, ...	0.07	1	900 00
Total, ...	0.46	5	$1,473 50
South Metropolitan District.			
Quincy, ...	41.10	22	$50,435 00
Milton, ...	3.89	19	18,095 00
Hyde Park, ...	2.27	2	187 50
West Roxbury, ...	1.29	8	5,800 00
	48.55	51	$74,517 50
Quincy pumping station, ...	2.75	1	97,984 46
Total, ...	51.30	52	$172,501 96
Aggregates, ...	51.76	57	$173,975 46

VI. SEWERAGE WORKS — MAINTENANCE.

(1) North Metropolitan System.

The maintenance of the North Metropolitan System involves the operation of the Deer Island, East Boston, Charlestown and Alewife Brook pumping stations, and the care of the sewers, siphons and outlets. With the 55.39 miles of sewer belonging to the Metropolitan Works there are connected nearly 500 miles of local sewers.

These stations contain 12 pumping engines, having a capacity amounting to 396,000,000 gallons per day, with lifts varying from 8 to 19 feet. The cost per million gallons raised one foot, including labor at the screens, was, at the Deer Island station, $0.086; at the East Boston station, $0.070; at the Charlestown station, $0.147; and at the Alewife Brook station, $0.285.

(2) South Metropolitan System.

The only pumping station now operated in the South Metropolitan System is the Quincy station. In connection with the 27.08 miles of Metropolitan sewers, there are local sewers connected nearly 350 miles in length.

The Quincy station has been operated by the Board only since April 1, 1901. It has two engines, having a total capacity of 8,000,000 gallons, with a lift of 36 feet.

VII. SEWERAGE WORKS — FINANCIAL STATEMENT.

(1) Construction Loans and Receipts.

The appropriations for the construction of the Metropolitan Sewerage Works, the receipts which are added to the appropriations, and the expenditures for construction, have been as follows: —

(*a*) *North Metropolitan System.*

Appropriation under chapter 439 of the Acts of 1889 (portion of original loan of $5,000,000 devoted to this system), . . .	$4,210,865 73
Appropriation under chapter 307 of the Acts of 1894, additional loan,	500,000 00
Appropriation under chapter 294 of the Acts of 1895, additional loan,	300,000 00
Amount carried forward, ...	$5,010,865 73

Amount brought forward,	$5,010,865 73
Appropriation under chapter 414 of the Acts of 1896, for Greenwood and Boyntonville (Wakefield),	30,000 00
Appropriation under chapter 88 of the Acts of 1897, for Greenwood and Boyntonville (Wakefield), additional loan,	5,000 00
Appropriation under chapter 436 of the Acts of 1897, for additional outlet in Stoneham,	10,000 00
Appropriation under chapter 520 of the Acts of 1897, for Lexington extension,	70,000 00
Appropriation under chapter 215 of the Acts of 1898, for additional outlet in Everett,	60,000 00
Appropriation under chapter 424 of the Acts of 1898, for additions to existing pumping plants,	155,000 00
Appropriation under chapter 172 of the Acts of 1900, for Wakefield branch,	175,000 00
Appropriation under chapter 184 of the Acts of 1900, for additional outlets in Chelsea and Everett,	90,000 00
	$5,605,865 73
Proceeds from sales of property and from other sources to December 31, 1901,	16,057 53
	$5,621,923 26
Amount approved by the Metropolitan Sewerage Commission and the Metropolitan Water and Sewerage Board for payment to December 31, 1901 (of which $248,433.44 is for the preceding fifteen months),	5,565,707 81
Balance, January 1, 1902,	$56,215 45

(*b*) *South Metropolitan System.*

Charles River Valley Sewer.

Appropriation under chapter 439 of the Acts of 1889 (portion of original loan of $5,000,000 devoted to this system),	$789,134 27
Appropriation under chapter 464 of the Acts of 1900, for siphon purchase in Watertown,	10,912 00
	$800,046 27
Amount approved by the Metropolitan Sewerage Commission for payment to December 31, 1901,	800,046 27
No balance, January 1, 1902,	–

Neponset River Valley Sewer.

Appropriation under chapter 406 of the Acts of 1895, original loan,	$500,000 00
Appropriation under chapter 83 of the Acts of 1897, additional loan,	300,000 00
Appropriation under chapter 180 of the Acts of 1898, additional loan,	35,000 00
Appropriation under chapter 241 of the Acts of 1899, additional loan,	25,000 00
Appropriation under chapter 204 of the Acts of 1901, additional loan,	40,000 00
	$900,000 00
Proceeds from pumping ground water, ...	109 50
	$900,109 50
Amount approved by the Metropolitan Sewerage Commission and the Metropolitan Water and Sewerage Board for payment to December 31, 1901 (of which $12,607.68 is for the preceding fifteen months), ...	866,290 16
Balance, January 1, 1902, ...	$33,819 34

High-level Sewer.

Appropriation under chapter 424 of the Acts of 1899, original loan,	$4,600,000 00
Proceeds from sales of property to December 31, 1901, . . .	575 00
	$4,600,575 00
Amount approved by the Metropolitan Sewerage Commission and the Metropolitan Water and Sewerage Board for payment to December 31, 1901 (of which $1,371,981.64 is for the preceding fifteen months), ...	1,763,892 58
Balance, January 1, 1902, ...	$2,836,682 42

(c) *Metropolitan Sewerage Loans Sinking Fund.*

Under authority of chapter 122 of the Acts of 1899, and section 14 of chapter 424 of the Acts of 1899, the Treasurer of the Commonwealth was required to consolidate the sinking funds of all the Metropolitan sewerage loans into one fund, to be known as the Metropolitan Sewerage Loans Sinking Fund.

The sinking fund as thus established has amounted at the end of each year to sums as follows: —

December 31, 1899, ...	$361,416 59
December 31, 1900, ...	454,520 57
December 31, 1901, ...	545,668 26

(2) Annual Appropriations and Receipts.

The annual appropriations for the maintenance of the Metropolitan Sewerage Works, the receipts of the Board which are added to the appropriations for maintenance, and the expenditures for maintenance for the fifteen months ending December 31, 1901, have been as follows: —

North Metropolitan System.

Balance, October 1, 1900,	$51,995 80
Appropriation under chapter 40 of the Acts of 1901,	76,500 00
Receipts from pumping and from other sources,	325 02
	$128,820 82
Amount approved by the Boards for payment,	115,868 15
Balance, January 1, 1902,	$12,952 67

South Metropolitan System.

Balance, October 1, 1900,	$9,447 89
Appropriation under chapter 30 of the Acts of 1901,	76,060 00
Receipts from sales of property and from pumping,	10 00
	$85,517 89
Amount approved by the Boards for payment,	73,998 61
Balance, January 1, 1902,	$11,519 28

The Board has also received from rentals and from other sources, to be applied by the Treasurer of the Commonwealth to the Metropolitan Sewerage Loans Sinking Fund requirements, $318.85.

(3) Annual Assessments.

Chapter 424 of the Acts of the year 1899 provided that the Supreme Judicial Court should determine the proportion in which each of the cities and towns of the South Metropolitan System should, for the term of five years next after the year of the first issue of scrip or certificates of debt under said chapter, annually pay money into the treasury of the Commonwealth to meet the interest and sinking fund requirements, and the cost of maintenance and operation of the system. The award of the commission appointed in the year 1900, covering the term of five years beginning with the year 1900 and ending with the year 1904, is shown on pages 32 and 33 of the twelfth annual report of the Metropolitan Sewerage Commission.

Chapter 439 of the Acts of the year 1889 provided in a similar manner for the appointment of commissioners in every term of five years to determine the proportion in which each of the cities and towns forming the North Metropolitan System should annually pay money to meet the interest and sinking fund requirements, and the cost of maintenance and operation of that system. On May 16, 1901, the Supreme Judicial Court appointed James F. Jackson of Fall River, Larkin T. Trull of Lowell and Arthur P. Rugg of Worcester commissioners to determine the amount of these annual payments, beginning with the year 1901 and ending with the year 1905; and the full award of the commissioners will be found in Appendix No. 6.

The proportions in percentages which are determined to be payable by the several cities and towns are as follows: —

CITY OR TOWN.	Proportions in Percentages for Interest and Sinking Fund, based on Valuation.	Proportions in Percentages for Maintenance and Operation, based on Population.
Arlington,	2.89	2.06
Belmont,	1.50	.94
Boston,*	16.89	20.66
Cambridge,	25.75	21.96
Chelsea,	6.20	8.14
Everett,	4.81	5.82
Lexington,†	.90	.32
Malden,	8.16	8.05
Medford,	5.40	4.36
Melrose,	3.41	3.10
Somerville,	13.87	14.74
Stoneham,	1.35	1.48
Wakefield,	2.35	1.78
Winchester,	2.41	1.73
Winthrop,	1.81	1.45
Woburn,	2.80	3.41
Totals,	100.00	100.00

* East Boston and Charlestown districts. † Villages of Centre and East Lexington.

(4) Expenditures for the Different Works.

The following is a summary of the expenditures made in the various operations for the different works: —

CONSTRUCTION.	For Fifteen Months ending December 31, 1901.		From Beginning of Work to December 31, 1901.	
North Metropolitan System.				
Original system, main line and branches,	$8,728 86		$5,150,782 53	
Lexington branch,	-		68,585 15	
Everett branch,	-		54,877 12	
Wakefield branch,	86 00		35,698 29	
Stoneham branch,	-		11,574 10	
Chelsea and Everett outlets,	65,996 56		67,805 71	
Wakefield branch extension,	173,622 02		176,384 91	
Total, North Metropolitan System,		$248,433 44		$5,565,707 81

CONSTRUCTION.	For Fifteen Months ending December 31, 1901.		From Beginning of Work to December 31, 1901.	
South Metropolitan System.				
Charles River valley sewer,	-			$800,046 27
Neponset River valley sewer, main line,	$8,120 20		$856,802 68	
Brookline branch,	9,487 48		9,487 48	
Total,		$12,607 68		866,290 16
High-level sewer: —				
Section 43, Quincy,	$3,165 75		$8,571 87	
Section 44, Quincy,	2,084 48		6,199 48	
Section 45, Quincy,	943 66		3,625 62	
Section 46, Quincy,	1,115 65		3,797 61	
Section 47, Quincy,	5,761 32		8,443 28	
Sections 48 and 49, embankments, Quincy,	24,453 00		24,453 00	
Section 48, Quincy,	2,288 59		4,970 55	
Section 49, Quincy,	54,807 22		57,489 18	
Section 50, Quincy,	8,201 02		10,882 98	
Section 51, Quincy,	58,555 82		61,237 78	
Section 52, Quincy,	10,197 36		12,879 32	
Section 53, Quincy,	5,766 19		8,448 15	
Section 54, Quincy,	4,832 83		7,514 79	
Section 55, Quincy and Milton,	103,979 15		106,661 11	
Section 56, Milton,	80,429 59		83,111 55	
Section 57, Milton,	5,661 97		8,343 93	
Section 58, Milton,	3,491 32		6,173 28	
Section 59, Milton,	7,482 44		10,164 40	
Section 60, Milton,	1,700 14		4,382 10	
Section 61, Milton,	894 69		3,576 65	
Section 62, Milton,	107,421 08		110,103 03	
Section 63, Milton,	81,736 42		84,418 37	
Section 64, Neponset River crossing,	1,175 33		3,857 28	
Section 65, Hyde Park,	23,086 04		40,503 13	
Section 66, Hyde Park,	92,484 17		114,858 13	
Section 67, Hyde Park, Stony Brook crossing,	4,620 46		7,302 41	
Section 68, Hyde Park and Roxbury,	22,874 24		78,213 66	
Section 69, West Roxbury,	42,315 20		101,861 64	
Section 70, West Roxbury,	61,689 64		86,507 44	
Section 71, West Roxbury,	63,557 67		87,588 67	
Section 72, West Roxbury,	108,562 61		111,251 98	
Section 73, West Roxbury,	36,996 87		39,678 28	
Section 74, West Roxbury and Roxbury,	119,643 63		122,328 28	
Section 75, Roxbury,	26,846 51		36,202 78	
Section 76, Roxbury, cast-iron force main,	901 17		3,582 12	
Section 77, Roxbury, Ward Street pumping station,	6,841 24		10,973 79	
Section 78, Roxbury, connecting sewer,	287 53		1,240 90	
Real estate,	175,794 13		254,778 45*	
Apportionment Commission,	-		2,000 00	
Administration,	9,345 56		25,715 66	
Total,		1,371,981 64		1,763,892 58
Total, South Metropolitan System,		$1,384,589 32		$3,430,229 01
Total for construction, both systems,		$1,633,022 76		$8,995,936 82

* Including $61,300.20 paid for Ward Street pumping station lot, and estimated amount of $14,000 for part of Adams estate purchase on account of sand for use in connection with construction of Section 48.

MAINTENANCE.	For Fifteen Months ending December 31, 1901.
North Metropolitan System,	$115,868 15
South Metropolitan System,	73,998 61
Total for maintenance,	$189,866 76

(5) DETAILED FINANCIAL STATEMENT.

The Board herewith presents, in accordance with the Metropolitan Sewerage Acts, an abstract of the expenditures and disbursements, receipts, assets and liabilities for the fifteen months ending December 31, 1901: —

(*a*) *Expenditures and Disbursements.*

GENERAL CHARACTER OF EXPENDITURES.	For Fifteen Months ending December 31, 1901.
North Metropolitan System — Construction.	
Commissioners,	$916 66
Secretary, engineer and auditor,	1,262 50
Clerical services,	1,141 68
Engineers, inspectors, rodmen, laborers and others,	26,393 34
Advertising,	220 02
Office supplies,	259 99
Postage, telephone and telegrams,	135 07
Books, maps, plans, blue prints and photography,	211 38
Engineering instruments and repairs of same,	45 79
Engineering supplies,	325 74
Carriage hire and travelling expenses,	634 68
Rent of office, Pemberton Building,	312 50
Rent of office, Melrose,	160 00
Teaming and express,	131 64
Tools and repairs of same,	301 66
Brick, cement, lumber and other field supplies,	9,240 36
Contracts: —	
Original work: —	
James Heath & Son, Sect. 35,	75 75
Wakefield branch: —	
John Booth Co., Sect. 50,	86 00
Chelsea and Everett outlets: —	
H. A. Hanscom & Co., Sect. 56,	31,747 71
H. A. Hanscom & Co., Sect. 57,	21,827 79
Wakefield branch extension: —	
Bruno, Salomone & Petitti, Sect. 58,	49,110 33
Chas. G. Belden & Co., Sect. 59,	47,719 76
Old Colony Construction Co., Sect. 60 (part),	10,841 01
Metropolitan Contracting Co., Sect. 60 (part),	35,571 58
Pumps and alterations, pumping plants,	7,860 00
Land takings, purchase and recording,	1,480 50
Experts and appraisers,	63 75
Legal services,	356 25
	$248,433 44
Neponset River Valley Sewer.	
Engineers, inspectors, rodmen, laborers and others,	$1,971 82
Advertising,	47 18
Office supplies,	13 79
Postage, telephone and telegrams,	31 90
Books, maps, plans, blue prints and photography,	23 58
Engineering instruments and repairs of same,	9 00
Amount carried forward,	$2,097 27

GENERAL CHARACTER OF EXPENDITURES.	For Fifteen Months ending December 31, 1901.
Amount brought forward,	$2,097 27
Neponset River Valley Sewer — Con.	
Engineering supplies,	105 55
Carriage hire and travelling expenses,	77 00
Teaming and express,	1 15
Brick, cement, lumber and other field supplies,	184 82
Contracts: —	
Brookline branch: —	
Thos. J. Kelley, Sect. 30,	6,942 59
Land takings, purchase and recording,	1,930 80
Experts and appraisers,	225 00
Legal services,	43 50
Claims on contracts,	1,000 00
	$12,607 68
High-level Sewer — Construction.	
Commissioners,	$4,750 00
Secretary, engineer and auditor,	5,879 15
Clerical services,	2,239 53
Engineers, inspectors, rodmen, laborers and others,	95,733 28
Advertising,	1,008 82
Office supplies,	2,382 42
Postage, telephone and telegrams,	536 45
Books, maps, plans, blue prints and photography,	921 37
Engineering instruments and repairs of same,	582 84
Engineering supplies,	2,323 11
Carriage hire and travelling expenses,	3,211 96
Repairs, fittings and supplies, main office,	118 77
Rent of office, Pemberton Building,	3,281 25
Rent of sub-offices,	672 75
Water rates and connections,	9,220 50
Clearing wood lot, Quincy,	888 77
Rent of office, Ashburton Place,	300 00
Rent of wharf, Quincy,	675 00
Boats and boat hire,	25 00
Teaming and express,	451 28
Tools and repairs of same,	21 84
Brick, cement, lumber and other field supplies,	10,125 32
Contracts: —	
Chas. G. Belden & Co., Sect. 47,	3,804 90
Chas. G. Belden & Co., Sect. 49,	50,423 48
Chas. G. Belden & Co., Sects. 48, 49, embankments,	19,188 46
Chas. G. Belden & Co., Sect. 50,	6,209 57
Thomas F. Moore, Sect. 51,	54,934 63
National Contracting Co., Sect. 52,	8,164 75
National Contracting Co., Sect. 53,	3,928 43
National Contracting Co., Sect. 54,	3,178 67
H. P. Nawn, Sect. 55,	93,075 17
National Contracting Co., Sect. 56,	76,733 30
J. W. Bustin & Co., Sect. 57,	3,468 17
Latta & Terry Co., Sect. 58,	711 87
H. P. Nawn, Sect. 59,	4,486 89
E. W. Everson & Co., Sect. 62,	100,386 83
National Contracting Co., Sect. 63,	71,793 78
Amount carried forward,	$645,838 31

GENERAL CHARACTER OF EXPENDITURES.	For Fifteen Months ending December 31, 1901.
Amount brought forward,	$645,838 31
High-level Sewer — Construction — Con.	
Contracts — *Con.*	
Beckwith & Quackenbush, Sect. 65,	21,025 75
Ed. W. & John J. Everson, Sect. 66,	85,951 71
Beckwith & Quackenbush, Sect. 68,	21,384 26
Beckwith & Quackenbush, Sect. 69,	38,494 89
Charles Linehan, Sect. 70,	55,400 77
Charles F. Taylor & Co., Sect. 71,	59,987 71
Jones & Meehan, Sect. 72,	101,063 22
National Contracting Co., Sect. 73,	30,811 12
H. P. Nawn, Sect. 74,	111,947 10
Shailer & Schniglau Co., Sect. 75 (part),	22,710 89
Land takings, purchase and recording,	170,713 94
Experts and appraisers,	2,621 77
Legal services,	2,380 20
Claims and allowances on contracts,	1,650 00
Total,	$1,371,981 64
North Metropolitan System — Maintenance.	
Administration: —	
Commissioners, secretary, auditor and assistants,	$1,697 19
Postage, printing, stationery and office supplies,	248 05
Miscellaneous expenses,	401 62
General superintendence: —	
Engineer and assistants,	6,841 56
Postage, printing, stationery and office supplies,	435 49
Rent, telephone, heating, lighting and care of offices,	370 35
Miscellaneous expenses,	204 24
Deer Island pumping station: —	
Labor,	12,520 07
Coal,	7,111 47
Oil and waste,	488 60
Water,	1,639 20
Packing,	88 35
Repairs and renewals,	949 84
Telephones and office supplies,	320 11
Miscellaneous supplies and expenses,	1,575 96
East Boston pumping station: —	
Labor,	12,363 44
Coal,	9,809 70
Oil and waste,	280 92
Water,	1,083 60
Packing,	72 12
Repairs and renewals,	1,769 56
Telephones and office supplies,	219 05
Miscellaneous supplies and expenses,	1,018 47
Charlestown pumping station: —	
Labor,	11,256 67
Coal,	4,237 20
Oil and waste,	322 98
Water,	484 80
Packing,	139 72
Amount carried forward,	$77,950 33

GENERAL CHARACTER OF EXPENDITURES.	For Fifteen Months ending December 31, 1901.
Amount brought forward,	$77,950 33
North Metropolitan System — Maintenance — Con.	
Charlestown pumping station — *Con.*	
Repairs and renewals,	838 35
Telephones and office supplies,	239 99
Miscellaneous supplies and expenses,	921 22
Alewife Brook pumping station: —	
Labor,	3,746 79
Coal,	2,014 46
Oil and waste,	130 09
Water,	384 16
Packing,	21 05
Repairs and renewals,	169 21
Telephones and office supplies,	215 92
Miscellaneous supplies and expenses,	621 25
Sewer lines, labor,	21,824 08
Supplies and expenses,	4,791 25
Apportionment Commission,	2,000 00
Total,	$115,868 15
South Metropolitan System — Maintenance.	
Administration: —	
Commissioners, secretary, auditor and assistants,	$333 33
Postage, printing, stationery and office supplies,	120 98
General superintendence: —	
Engineer and assistants,	1,288 34
Postage, printing, stationery and office supplies,	13 88
Charles River valley sewer: —	
Sewer lines, labor,	3,368 50
Supplies and expenses,	116 59
City of Boston, for pumping and interest,	44,345 39
Neponset River valley sewer: —	
Sewer lines, labor,	2,151 28
Supplies and expenses,	144 75
City of Boston, for pumping and interest,	17,290 00
Quincy pumping station:* —	
Labor,	2,392 28
Coal,	1,288 42
Oil and waste,	19 91
Water,	10 00
Packing,	15 98
Repairs and renewals,	448 34
Telephones and office supplies,	44 42
Miscellaneous supplies and expenses,	606 22
Total,	$73,998 61

* From April 1, 1901.

(*b*) *Receipts.*

The receipts from the sales of property, from rents and from other sources have been credited as follows: —

	For Fifteen Months ending December 31, 1901.	From Beginning of Work to December 31, 1901.
North Metropolitan System, — construction,	$6,765 55	$16,057 53
Neponset River valley sewer, — construction,	-	109 50
High-level sewer, — construction,	575 00	575 00
North Metropolitan System, — maintenance,	325 02	325 02
South Metropolitan System, — maintenance,	10 00	10 00
Metropolitan Sewerage Loans Sinking Fund,	318 85	318 85
Totals,	$7,994 42	$17,395 90

(c) *Assets.*

The following is an abstract of the assets, the more important items being given: —

Office furniture, fixtures and supplies: —

2 book cases; 8 plan cases; 37 miscellaneous cases and cabinets; 137 chairs; 17 desks; 2 letter-copying presses; railroad tickets (value), $357.26; 25 reference books; 52 stools; 35 coal stoves; 25 tables (office); 26 tables (drafting); 1 telephone line (private); 1 typewriter; stamped envelopes (value), $18 50.

Engineering and scientific instruments and supplies: —

6 drawing boards; 1 calculating instrument; 1 cement-testing machine; 1 current meter; 9 engineers' levels; 2 pantographs; 1 photographic outfit; 6 planimeters; 94 levelling, measuring and sight rods; 84 pairs rubber boots; 84 scales; 2 section liners; 12 straight-edges; 60 tapes; 12 transits.

Horses, vehicles, field machinery, etc.: —

1 horse; 1 cart; 1 sled; 1 wagon; 1 road roller; 2 harnesses; 8 bush hooks, bill hooks, scythes, etc.; 2 hand carts; 3 iron hand rollers; 5 lawn mowers.

Machinery, tools and other appliances and supplies: —

7 adzes; 4 anchors; 7 anvils; 27 axes and hatchets; 32 barrows; 23 bars, crow and others; 1 blacksmithing outfit; 1 blasting battery; 52 blocks, all kinds; 4 blowers; 10 row boats; 1 boat, naphtha launch; 21 boilers; 102 chisels; 4 carts and cars; 9 chain hoists; 5 derricks; 14 drilling machines; 5 dynamos; 16 engines; 10 gages; 7 grindstones; 18 hoes, all kinds; 4 forks,; 56 hammers; 7 hoisting buckets; 1,695 feet hose, all sizes; 3 indicators; 2 injectors and inspirators; 11 jacks; 1,200 feet ladders; 3 lathes; 10 M feet B M. lumber; 4 mattocks; 15 mauls; 2 meters, pressure, etc.; 10 oil cabinets and tanks; 13 pipe cutters; 18 die plates, stocks, etc.; 72 picks; 3 plumber's furnaces; 14 pumping engines; 25 steam pumps; 1 centrifugal pump; 6 diaphragm pumps; 8 miscellaneous pumps; 15 rakes; 1 rock drill; 34 saws; 13 scales, yard, platform, etc.; 104 shovels, scoops, spades, etc.; 13 steam siphons; 43 temporary buildings and structures; 24 tongs; 24 tool and coal boxes, etc.,; 10 trench and other braces; 1 truck; 14 vises; 2 winches; 274 wrenches; 2,427 feet wrought-iron pipe, all sizes.

Real estate connected with works not completed: —

Land for the Ward Street pumping station, Roxbury; for the outfall sewer at Nut Island, Boston harbor; and for other portions of the high-level sewer.

Completed works, including real estate connected therewith: —

Pumping stations at Deer Island, East Boston, Charlestown, Somerville and Quincy; 82.47 miles of completed sewer; stock yards and buildings at Deer Island, East Boston and at Hyde Park, and vacant lots in Winthrop and Chelsea.

(*d*) *Liabilities.*

There are liabilities as follows: —

Unpaid bills, ...	$18,400 00*
Due on monthly pay rolls, ...	1,886 00
	$20,286 00

Amounts on Monthly Estimates, not due until Completion of Contracts or until Claims are settled.

NAME.	Work.	Amount.
North Metropolitan Construction: —		
The George F. Blake Manufacturing Co.	Original work, Alewife Brook pumping station.	$1,875 00
John Sheehan, . . .	Original work, Sect. 20, ...	450 00
John Sheehan, . . .	Original work, Sect 37, ...	4,458 18
Jones & Meehan, . . .	Original work, Sect. 44, ...	32 00
H. A. Hanscom & Co., .	Chelsea and Everett outlets, Sect. 56,	1,670 93
H. A. Hanscom & Co., .	Chelsea and Everett outlets, Sect. 57,	1,148 83
Bruno, Salomone & Petitti,	Wakefield branch extension, Sect. 58,	2,584 77
Chas. G. Belden & Co., .	Wakefield branch extension, Sect. 59,	2,511 57
Old Colony Const. Co., .	Wakefield branch extension, Sect. 60,	1,894 17†
Metropolitan Contg. Co., .	Wakefield branch extension, Sect. 60,	6,277 33
Neponset Valley System: —		
E. W. Everson & Co., . .	Original work, Sect. 25, . . .	50 00
Thos. J. Kelley, . .	Brookline branch, Sect. 30, . .	1,225 16
High-level sewer: —		
Chas. G. Belden & Co., .	Sect. 47, ...	671 45
Chas. G. Belden & Co., .	Sects. 48, 49, embankments, . .	3,386 21
Chas. G. Belden & Co., .	Sect. 49, ...	8,898 25
Chas. G. Belden & Co., .	Sect. 50, ...	1,095 81
Thomas F. Moore, . .	Sect. 51, ...	9,879 48
National Contracting Co., .	Sect. 52, ...	1,661 39
National Contracting Co., .	Sect. 53, ...	747 74
National Contracting Co., .	Sect. 54, ...	679 62
H. P. Nawn, ...	Sect. 55, ...	8,529 94
National Contracting Co., .	Sect. 56, ...	13,663 60
J. W. Bustin & Co., . .	Sect. 57, ...	612 03
Latta & Terry Co., . .	Sect. 58, ...	125 63
H. P. Nawn, ...	Sect. 59, ...	884 66
E. W. Everson & Co., .	Sect. 62, ...	6,034 77
National Contracting Co., .	Sect. 63, ...	12,928 52
E. W. & John J. Everson, .	Sect. 66, ...	18,543 70
Charles Linehan, . .	Sect. 70, ...	13,480 48
Charles F. Taylor & Co., .	Sect. 71, ...	4,206 98
Jones & Meehan, . .	Sect. 72, ...	6,121 57
National Contracting Co.,	Sect. 73, ...	5,481 82
H. P. Nawn, ...	Sect. 74, ...	4,535 33
E. W. Everson & Co., .	Sect. 75, ...	184 50
		$146,531 42

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* Miscellaneous current bills of 1901 and those coming in from time to time after January 1, 1902, have since been paid.

† Labor and other claims paid by the Board exceed this amount.

Amounts have been agreed upon in the following cases, but the deeds have not yet passed: —

Heirs of Austin White, $100; William Bogle, $1,250; George H. Hardwick, $75; Jennie M. Kimball, $500.

On the claims of the following it is impossible to state the amounts due for land and other damages, as suits are now pending in the courts for the determination of the same: —

Joseph Stone *et al.*, Amos Stone *et al.*, city of Boston, Henry W. Hunt *et al.*, Peter P. Veale, Margaret Noon, Evangelical Lutheran Church, William Finneran, Harvard College, Charles L. Flint, Jacob Schaffreen, Theodore H. Tyndale, John Sheehan, Mary E. Connolly, Mary Rohan.

VIII. ADMISSION OF OTHER MUNICIPALITIES INTO THE METROPOLITAN WATER DISTRICT.

In accordance with negotiations which were taking place at the end of the preceding year, Stoneham was admitted into the Metropolitan Water District on May 23, 1901. It was agreed between the Board and the town that water might be furnished to the town from a reservoir to be constructed by the Board on Bear Hill at an elevation of between 295 and 300 feet above the Boston city base, when full, and that water should be delivered into main pipes of the town at the junction of Main and Franklin streets. As the building of a reservoir on Bear Hill, the laying of a considerable length of main pipe in order to connect with the Stoneham water system, and the extra pumping, involved the expenditure of a considerable sum of money, the payment of $30,000 by the town was required. These works were so far completed that water was supplied to the town on October 21, 1901.

IX. ADDITIONAL LOANS AND CHANGES OF ASSESSMENTS FOR METROPOLITAN WATER WORKS.

Attention was called, in the report of the Metropolitan Water Board of last year, to the necessity of authorizing an additional water loan, in order to provide for expenditures which had not been contemplated by the original Metropolitan Water Act. A recommendation for such loan was made by the Governor in his message to the Legislature. The additional appropriation was principally required for the construction of the Weston Aqueduct, and for the amount adjudged to be due to the city of Boston on account of the taking of its works.

An act was accordingly passed, on June 5, 1901, authorizing a Metropolitan Water Loan to an amount not exceeding $13,000,000, in addition to the $27,000,000 previously authorized.

The attention of the Metropolitan Water District and of the Legislature had also been called to the provisions of the original Metropolitan Water Act, by which the annual assessments imposed upon the cities and towns in the District were insufficient for several years to meet the entire cost of maintenance, the interest on the loan and the requirements of the sinking fund. The assessments began in the year 1898, and, besides the amount of $42,500 added on account of the preliminary expenditures of the State Board of Health, the sum of $300,000 only was assessed for that year; and, although it was provided that an increase of $200,000 in the amount of the assessment should be made in each successive year, the annual assessments would be inadequate to meet the total of the annual requirements for several years, so that, to meet the successive deficiencies, the amount of the water loan ultimately necessary would have to be increased by about $4,000,000.

Chapter 489 of the Acts of the year 1901 was passed on June 13, and provided that the assessment for the current year, and of each year thereafter, should be sufficient to meet the annual requirements for maintenance, interest and the sinking fund. Although the passage of this act increased to a considerable extent the amount of the assessment for the year 1901 over that of the preceding year, this action will result in a smaller maximum assessment in the future, and wisely requires the payment of current expenditures by current assessments.

X. MEASURES TO PREVENT WASTE AND EXCESSIVE USE OF WATER.

The Board deems it to be its duty to the Metropolitan Water District again to call attention, not only to the large consumption of water, but also to the great increase in consumption occurring from year to year. The State Board of Health in its report of 1895 stated that the average daily consumption of water in the Metropolitan District for the preceding year was 79,046,000 gallons. In that report the State Board estimated that the daily consumption would, in the year 1895, reach 84,000,000 gallons, or 85 gallons per inhabitant, and that the daily consumption in the year 1900 would reach 103,000,000 gallons, or 90 gallons per inhabitant. It was estimated that a consumption of 100 gallons per inhabitant would be reached in the year 1920; and, in making its calculations as to future needs of the District, it was estimated that, with the consumption of 100 gallons per inhabitant, the sources of supply then recommended would be sufficient until the year 1920. The district for which the calculation was made embraced not simply the cities and towns now in the District, but all the cities and towns within the ten-mile limit.

In the year 1895 the daily consumption in the cities and towns now constituting the District amounted to 69,188,000 gallons, — a daily consumption per inhabitant of 92 gallons. In the year 1901 the daily consumption of water in the District had reached 104,178,000 gallons, — a daily consumption of 117 gallons per inhabitant.

A greater increase than was estimated called for the construction of the Weston Aqueduct two or three years prior to the time when its need had been anticipated. An increase in the next few years corresponding to that which has occurred since the beginning of the operations of the Board will compel resort to be had in a very few years to additional sources of supply, at a date ten or twelve years earlier than had been estimated under the calculations made by the State Board of Health in the year 1895.

It is not necessary to repeat that this increase in consumption causes a great increase in the annual expenditures for maintenance and operation, and that it hastens the time when great expenditures must be incurred for new sources of supply, new pumping facilities, new aqueducts, and new mains and other equipments.

The Board continues of the belief that the annual consumption of water in the District is greater than is necessary, and that there is considerable waste and misuse of water. It has during the year continued to urge many of the municipalities to adopt stricter regulations in the consumption of water and to make a more rigorous enforcement of rules.

The Board, acting under the authority granted to it under section 10 of the Metropolitan Water Act, which provides that the Board may take all proper measures to prevent the improper use or waste of water, adopted, on August 2, 1901, the following regulations in regard to the use of hand hose and lawn sprinklers, to be enforced throughout the District on and after January 1, 1902: —

> The use of water through hand hose on premises where the water supply is *not* metered shall be restricted to two hours in each day, such use to be had between the hours of 5 and 8 A.M. and 5 and 8 P.M.
>
> The hose must be used with a nozzle not exceeding three-sixteenths of an inch in diameter, and while so used must be held in the hand of a person on the premises of the water taker.
>
> On premises where the water supply *is* metered, the above restrictions do not apply, and a lawn sprinkler may be attached to the hose.

The Board also gave notice that the charge for hand hose used in accordance with these regulations would not be less than $4 per annum.

The question of the prevention of the excessive use and waste of water was made the subject of conferences between the Board and the various water boards and other officials in the District in the early part of the year. The subject, as more especially discussed, was the introduction of water meters to individual water takers. There was considerable difference in opinion as to whether the time had come for either compelling or for urging or directly encouraging the use of meters by individual takers; but there seemed to be a general opinion expressed that it would be wise that the water supplied to the various cities and towns should be measured, and that the amount of the consumption of water should become an element in fixing, so far as practicable, the annual assessment.

The Board accordingly caused investigations to be made as to the feasibility of determining, by meters or otherwise, the amount of water furnished to each city and town in the District; and, although it was ascertained that the cost of such determinations would be considerable, it seemed that such cost would be justified, even if not called for on other grounds, if the different cities and towns could thus be given a pecuniary motive for enforcing proper regulations against waste and excessive use of water.

Inasmuch as the Metropolitan Water Act provided that the annual assessments upon the cities and towns, other than the city of Boston, should be apportioned one-third in proportion to their respective valuations and the remaining two-thirds in proportion to their respective populations, the Board believed that to substitute for the element of population the quantity of water used, so that the assessment should be based one-third in proportion to the valuations and two-thirds in proportion to the quantities of water respectively used, would be a step in the direction of checking waste and excessive use, and would operate for the benefit of the entire District.

The Board trusts that the results of the investigations which it has begun upon this subject will enable it to make future recommendations tending further to check unnecessary consumption.

The inadequacy of the present aqueducts to furnish the quantities of water required under the larger consumption in periods of excessive drafts upon the works may require at times a special economy in use until the new Weston Aqueduct is able to aid the resources of the present aqueducts.

XI. ELECTROLYSIS AFFECTING IRON PIPES.

The Board has been having extended investigations made as to the effects upon iron pipes of the underground electric currents. For some years injurious effects have been observed from the action of electricity upon water and other pipes. The examinations which have been made are convincing that the electric currents from the street railway systems have already caused serious damage to the pipe lines. This injury has thus far, in general, been found in pipes in the vicinity of the power stations of the street railway systems, but it is probable that the injuries exist in other places, and especially that there has been destructive action taking place at the joints of the pipes.

The injury which has already been caused is of large amount, and, if the present conditions continue, they will result in a large destruction of pipes within a very few years. The cost, however, of replacing these pipes is but a minimum of the damage which may be occasioned. By the sudden breakage of pipes, large damage may be caused to neighboring property in thickly settled districts, and serious consequences may ensue where large portions of the District are dependent upon a single line of pipe.

It would seem that this electrical action, resulting from the operation of electric railways, may be prevented by the use of a double trolley system, in which return currents shall be insulated from the rails and from the earth.

The damages which are occasioned are by no means confined to the pipes belonging to the Metropolitan Water and Sewerage Board.

The attention of the railway companies has been from time to time called to the matter, but it would seem that efficient and radical measures must soon be called for to remedy these difficulties.

XII. RECOMMENDATIONS FOR LEGISLATION.

In a preliminary report made to the Legislature (House Document, No. 26) the following recommendations for legislation for the current year, under both the water and sewerage acts, were made: —

> Application has been made to the Board in one or two instances that a supply of water from the Metropolitan System be furnished to sections of a town that is embraced within the ten-mile limit prescribed by the Metropolitan Water Act (chapter 488 of the Acts of the year 1895), which are not reached by the water pipe system that supplies the larger portion of the town. If a town is within the ten-mile limit, the act provides that the Board shall admit the town, on its application, into the District, and furnish it water; or shall furnish water to any water company owning the water pipe system in the town, on such company assuming the assessments of the town, if any, and such payment of money as the Board may determine. The act does not contemplate the existence of two or more water companies or systems supplying water to different sections of a town. Were such town without the ten-mile limit, the Board might under the act furnish any such section with water, upon such payment of money as the Board might determine. Recommendation is made that the act be so amended that the Board may furnish water to a water company in a town within the ten-mile limit, but not admitted into the District, which owns the water pipe system of a section of a town, on the water company paying such sum of money as the Board may determine, such sum to exceed in any case the proper proportion of the entire assessment which would be imposed upon the town were it a part of the Metropolitan Water District.
>
> By the various acts under which the Metropolitan Sewerage Commissioners were authorized to construct the different systems of sewerage, different points of time were fixed at which the taking of lands for sewer purposes should take effect. It would seem, though not without some doubt, that, at the time of the consolidation of the commission with the Metropolitan Water Board, the statutes provided that the takings of lands for the sewerage works should take effect on the passage by the Board of the order for the taking; on the other hand, the Metropolitan Water Act provided that all takings of lands for water works should take effect upon the recording of the instrument of taking in the registry of deeds. It is manifestly desirable that no doubt should exist as to the time when the takings become effective, and that the same rule should apply to all takings of land by the consolidated Board; and the Board recommends the passage of an act to this effect.

XIII. FUTURE WORK.

Upon both the water and sewerage works a large amount of construction work will be required during the coming year.

The stripping and removal of soil from the Wachusett Reservoir will be continued as rapidly as during the last year; the work upon the Wachusett Dam and Weston Aqueduct, which has been well begun, will be prosecuted with larger forces; considerable lines of main pipe will be laid in order to convey water from the Weston Aqueduct into the District, and to complete a second connection between Chestnut Hill Reservoir and Spot Pond; the excavation and improvement of the Pegan Brook Meadow in Lake Cochituate will require vigorous efforts for its completion within the time limited; and there will be need of a large amount of construction work in the relocation of the Central Massachusetts Railroad, an undertaking which will have to be well advanced toward completion during the year.

The construction of the high-level sewer in the South Metropolitan System, which has likewise been well advanced, will call for more sewerage work than in any previous year, and involve the difficult operations of laying submarine pipes for the outlet off Nut Island; a new pumping station at Ward Street in Roxbury must be begun, and engines and other equipment for its operation must be supplied.

The report of the Chief Engineer, relating to the Metropolitan Water Works, and the report of the Engineer of the Metropolitan Sewerage Works, are herewith submitted.

Respectfully submitted,

HENRY H. SPRAGUE.
HENRY P. WALCOTT.
JAMES A. BAILEY, Jr.

Boston, January 1, 1902.

REPORT OF THE CHIEF ENGINEER.

To the Metropolitan Water and Sewerage Board.

GENTLEMEN: — The following is a report of the operations of the Engineering Department of the Metropolitan Water Works for the year ending December 31, 1901.

ORGANIZATION.

The general organization of the Engineering Department remains the same as last year. The list of engineers reporting directly to the Chief Engineer is as follows: —

DEXTER BRACKETT, .	. *Engineer, Distribution Department.*
DESMOND FITZGERALD,	. *Engineer, Sudbury Department.*
THOMAS F. RICHARDSON,	. *Engineer, Dam and Aqueduct Department.*
HIRAM A. MILLER, .	. *Engineer, Reservoir Department.*
HORACE ROPES, . .	. *Engineer, Weston Aqueduct Department.*
ALFRED D. FLINN, .	. *Principal Office Assistant.*
JOHN N. FERGUSON, .	. *Office Assistant.*

Joseph P. Davis, A. Fteley and Hiram F. Mills have continued as consulting engineers.

John W. Lynch has continued in direct charge of the pumping stations at Chestnut Hill, and in general charge of the mechanical work at all other pumping stations of the Distribution Department.

Charles E. Haberstroh has continued as assistant superintendent in the Sudbury Department, in immediate charge of the storage reservoirs and other works on the Sudbury and Cochituate watersheds and of the Sudbury and Cochituate aqueducts.

George E. Wilde has continued as assistant superintendent in the Distribution Department, in immediate charge of the maintenance and operation of the pipe. lines and other works within the Metropolitan District, with the exception of the pumping stations, and is also engaged at times upon the work of construction.

At the beginning of the year the engineering force, including both those engaged upon the construction and maintenance of the works, numbered 159, and at the end of the year 158; and during the year fluctuated from a minimum of 147, in the spring, to a maximum of 190, in August.

In addition to the engineering force, which included the engineers engaged upon the inspection of the work, other inspectors have been employed upon masonry, earthwork and pipe laying. The maximum number so employed at any one time during the year was 12.

Gangs of men under the immediate direction of foremen and under the general direction of the engineers have been employed from time to time to do minor work, the more important items of which are improvements at Lake Cochituate, preliminary work at the Weston Reservoir, repairs at the Waban Hill Reservoir in Newton, and pipe laying in the Metropolitan Water District. There has also been a maintenance force, averaging 185, employed at the pumping stations and in connection with the maintenance of reservoirs, aqueducts, pipe lines, swamp ditches and other works.

Force Employed on Works.

The force employed upon the works in 1901 was considerably larger than the force employed in 1900, owing to the increased amount of contract work.

The largest force employed upon the works at any one time during the year was in the latter part of August, as follows: —

	Men.		Horses.	
Contractors' force: —				
Reservoir Department,	1,296		163	
Dam and Aqueduct Department,	312		16	
Weston Aqueduct Department,	819		113	
Distribution Department,	241		30	
		2,668		322
Day-labor force, construction,		40		2
Engineering force, including engineer inspectors and those engaged upon maintenance,		188		-
Inspectors not engineers,		10		-
Maintenance force, not including civil engineers,		203		-
		3,109		324

Arrangement of Report.

In continuing this report, it is the purpose to separate the work charged to the construction account from that charged to the maintenance account; but, as the work of construction and maintenance is supervised by the same principal engineers, and in very many cases the assistants are engaged upon both classes of work, it is not feasible to make a complete separation.

CONSTRUCTION.

CONTRACTS.

A detailed statement of the contracts made and pending during the year is given in Appendix No. 1. The following statement gives a summary of all the formal contracts charged to construction from the beginning of the work to the end of 1901: —

PORTION OF WORK.	Number of Contracts.	Approximate Amount.
Wachusett Reservoir, ...	24	$2,230,843 26
Wachusett Aqueduct and Clinton sewerage, . . .	20	1,516,259 67
Wachusett Dam, ...	3	1,629,406 56
Sudbury Reservoir, contracts assumed from the city of Boston (uncompleted portions), ...	11	583,220 54
Sudbury Department, reservoir, filter-beds, pipe lines and improvement of Lake Cochituate, contracts made by Metropolitan Water and Sewerage Board, . .	21	909,850 72
Weston Aqueduct and Reservoir, ...	14	1,815,129 50
Distribution Department, including pipes, valves and special castings purchased for other departments, .	138	4,117,447 75
Totals, ...	231	$12,802,158 00

Number of contracts made in 1901, ...	25
Number of contracts completed in 1901, ...	11
Total number of contracts made to December 31, 1901, ...	231

Amount of contracts made and assumed in 1896, including only the uncompleted portions of contracts assumed from the city of Boston, ...	$3,893,934 31
Amount of contracts made in 1897, ...	1,271,960 64
Amount of contracts made in 1898, ...	743,748 75
Amount of contracts made in 1899 (approximate), ...	2,398,411 47
Amount of contracts made in 1900 (approximate), ...	1,751,176 10
Amount of contracts made in 1901 (approximate), ...	2,742,926 73
	$12,802,158 00

Amount of contracts completed to December 31, 1900, ...	$6,862,991 67
Amount of contracts completed in 1901, ...	791,806 72
	$7,654,798 39
Amount of 26 contracts uncompleted December 31, 1901 (approximate), ...	5,659,359 61
	$13,314,158 00
Deduct for work done on 11 Sudbury Reservoir contracts by city of Boston, ...	512,000 00
	$12,802,158 00

Value of work done by contract to December 31, 1896, ...	$2,061,910 38
Value of work done by contract from January 1, 1897, to December 31, 1897, ...	2,647,063 53
Value of work done by contract from January 1, 1898, to December 31, 1898, ...	703,141 71
Value of work done by contract from January 1, 1899, to December 31, 1899, ...	1,206,791 72
Value of work done by contract from January 1, 1900, to December 31, 1900, ...	927,034 80
Value of work done by contract from January 1, 1901, to December 31, 1901, ...	1,067,540 70
	$8,613,482 84
Value of work remaining to be done on 26 uncompleted contracts December 31, 1901 (approximate), ...	4,188,675 16
	$12,802,158 00

In the case of all contracts completed up to the present time final settlements have been made without any legal controversy, and there have been no strikes of employés which went beyond an incipient stage or lasted more than two or three days.

RESERVOIR DEPARTMENT.

HIRAM A. MILLER, *Department Engineer.*

The organization of the engineering force has been substantially the same as during the previous year. Alexander E. Kastl, division engineer, in charge of the work at the North Dike, was on June 10, 1901, transferred to the Dam and Aqueduct Department, to take charge of surveys for the relocation of the Central Massachusetts Railroad; and Harry J. Morrison, assistant engineer, at the head of the engineering force at West Boylston, was promoted to the vacancy caused by this transfer. Charles E. Wells, division engineer, has continued in charge of the inspection of the removal of soil from the Wachusett Reservoir and the supervision of the contractors on that work. Charles A. Bowman, division engineer, has continued in charge of the force reports, measurements, estimates and miscellaneous engineering work connected with the removal of soil. Moses J. Look, assistant engineer, had charge of preliminary investigations, road construction and miscellaneous work, and on the promotion of Mr. Morrison was advanced to the place left vacant by him.

H. B. Wason, an engineer engaged on the inspection of the removal of soil from the reservoir, was stricken with typhoid fever on October 19, and died at the Clinton Hospital on October 28. This was the second year of his connection with the department. He showed unusual faithfulness and ability in the performance of the work entrusted to him.

The total engineering force in this department has varied from 47 to 68.

The main office of this department is in Clinton. Three branch offices, one near the North Dike, in Clinton, one at Sawyer's Mills and the other at West Boylston, have been continued throughout the year; and another one was established in the easterly part of West Boylston, in May, for one of the engineering parties engaged upon the removal of soil from the Wachusett Reservoir.

NORTH DIKE.

Work upon the North Dike has been in progress during the year under the contractors Nawn & Brock, Long & Little and the Newell & Snowling Construction Company.

The work done by each will be described more fully under the head of contracts. The total amount of work done during the year, with the total amount to date, is given in the following table: —

	To December 31, 1900.	For the Year 1901.	Total to December 31, 1901.
Soil and earth excavated from main cut-off trench (cubic yards),	499,856	-	499,856
Soil and earth excavated from secondary cut-off trench (cubic yards),	42,033	-	42,033
Sheet piling driven (linear feet),	5,245	-	5,245
Surface of rock uncovered and treated at bottom of main cut-off trench (square feet),	77,250	-	77,250
Soil from reservoir deposited in cut-off trenches and in the dike (cubic yards),	2,110,354	1,308,485	3,418,839
Earth and gravel taken from borrow pits and deposited in the dike (cubic yards),	42,725	55,630	98,355
Earth excavation for the construction of a small dike in Coachlace Pond (cubic yards),	19,172	-	19,172
Drain pipe laid at toe of the westerly portion of the dike (linear feet),	7,083	-	7,083

The present condition of the dike, relative to its completion, is as follows: The excavation of the main and secondary cut-off trenches, the filling with soil of the secondary cut-off trench and the driving of the sheet piling, had been completed at the beginning of 1901. The filling of the main cut-off trench with soil has continued during the year, and is substantially completed. Of the soil filling, which constitutes the principal part of the dike, 3,418,839 cubic yards have been deposited, which is 64 per cent. of the total amount required, as at present estimated.

Work has continued on the embankment of earth and gravel on the water side of the dike. The total amount deposited to the end of the year was 98,355 cubic yards.

The westerly portion of the dike, for a distance of 1,200 feet at its easterly end, was completed ready for the slope paving in October, and accepted from the contractor under the terms of the contract.

The consolidation of the soil placed in the dike is accomplished by saturating it with water. This work, which is done by a day-labor force, was in progress at the beginning of the year, and was continued until March 16, while the contract work was suspended. On November 14 a pump was located on the northerly shore of Sandy Pond, and pipes were laid from the pump to the dike for the purpose of continuing the saturation during the winter. The pump was started on December 11 and was kept in operation until the end of the year, most of the time day and night. Other day-labor work consisted of sowing grass seed on a finished portion of the dike, removing the buildings at the dike, cutting and burning weeds and digging test pits.

The maximum day-labor force employed at the dike was 27 men and 5 horses, for the week ending December 28, 1901.

RELOCATION AND CONSTRUCTION OF ROADS.

Considerable progress has been made on surveys and studies for the relocation of roads at the upper end of the reservoir, to take the place of those to be discontinued, but no contracts for road construction have been made during the year.

The determination of the location of a new road across the reservoir in West Boylston, connecting Worcester Street on the southerly side with Sterling and Lancaster streets on the northerly side, was made by the Board and was agreed to by the county commissioners of Worcester County on November 19, 1901.

The paving of the water channels along Boylston Street in Clinton and Boylston, along the Shrewsbury Road in Boylston and West Boylston, and along the new road from Clinton to West Boylston, in Sterling, where this paving is within or near the reservoir, has been maintained.

The soil used for dressing the slope of the embankment of Boylston Street, opposite Oak Street, slid from a portion of the embankment during the heavy rain of April 7. The embankment was drained by digging trenches in the clayey material and filling them with small stones before the soil was replaced.

The highway bridge in West Boylston, over the canal leading from the river to the Clarendon Mills, was repaired.

Some clearing and other preliminary work was done preparatory to the construction of the highway on the northerly side of the reservoir across the dike.

Several old roads in Boylston and West Boylston were discontinued as highways by the Board on June 1, 1901, so that they are no longer maintained by the towns in which they are situated. It is, however, necessary to keep them in condition for travel while the work is in progress, and many repairs have been necessary; some of these have been made by the contractors and some by the day-labor forces of the Board.

The maximum day-labor force employed in connection with the work upon the roads was 30 men and 10 horses, for the week ending May 25, 1901.

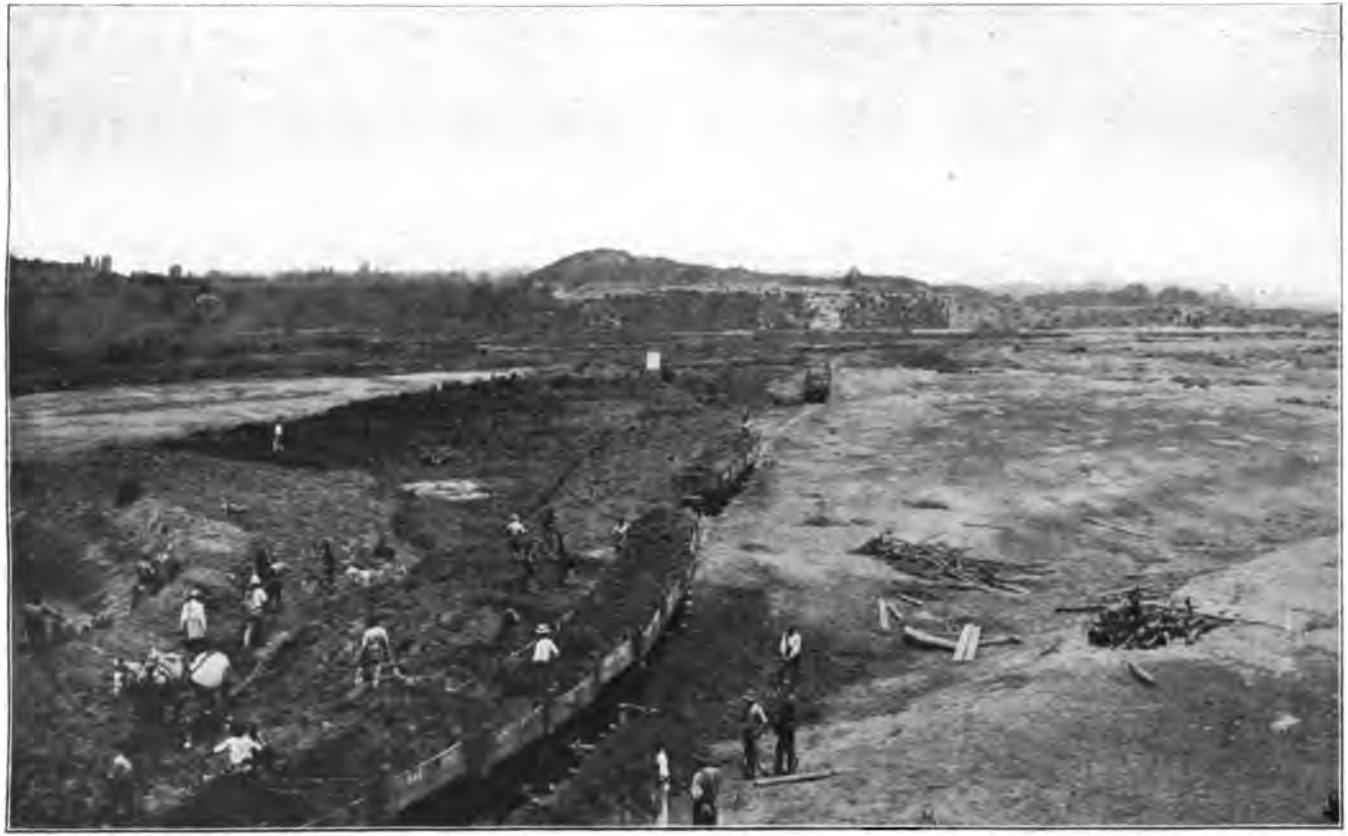
Considerable work has been done by the engineers in making plans for the location and construction of new roads toward the upper end of the reservoir and for the discontinuance of roads in other portions of the reservoir.

Removal of Soil.

Work upon the removal of soil from the reservoir has been in progress by the contractors already mentioned under the heading "North Dike."

A large contract for removing the soil required for completing the westerly portion of the dike has been made. This will be described more fully under the head of contracts.

The total amount of soil removed and to be removed from the Wachusett Reservoir is at present estimated to be about 6,900,000



WACHUSETT RESERVOIR—STRIPPING AND REMOVAL OF SOIL IN BOYLSTON.

UNIV. OF MICH.

cubic yards, from approximately 4,200 acres. Of this, the total amount removed from the reservoir in previous years was 2,278,723 cubic yards, from 1,358 acres; in 1901, 1,309,925 cubic yards were removed, from 758 acres; making a total from the beginning of work to the end of 1901 of 3,588,648 cubic yards, or 52 per cent. of the total, as at present estimated, removed from 2,116 acres. Of the soil remaining, the removal of more than one-half is provided for under existing contracts.

Of the soil removed to the end of the year 1901, 167,389 cubic yards were used for road embankments, 2,420 cubic yards for shallow-flowage areas, and 3,418,839 cubic yards have been used in the dike. There have been 40,885 cubic yards of earth used to cover deep muck to the depth of about 1 foot; this amount, added to the 9,008 cubic yards used for the same purpose during the previous year, gives a total of 49,893 cubic yards.

During the year, with the exception of a small portion which has been loaded into dump carts and hauled directly to the dike, the soil excavated has been loaded into cars, or first loaded into carts and then dumped into cars at the dumping platforms. A very large part of the soil loaded into cars has been hauled directly to the dike, by locomotives, over the main line of double track which passes near the South Clinton station. A considerable portion, however, has been hauled by locomotives to the foot of two inclines, and there hauled by stationary engines to the top of the bluff, to be again hauled by locomotives at a higher level to the dike. One of these inclines was situated on the northerly side of the river, about midway between the South Clinton station and Sawyer's Mills; the other, near the old West Boylston Road, a short distance west of Sawyer's Mills. During the early part of the year some soil was transported over a railway extending from the river, at the "Oxbow," to the dike, east of Coachlace Pond.

The plant employed in this work toward the end of the season, exclusive of horses and carts, included 27.3 miles of 3-foot-gage track, 25 8 to 16 ton locomotives, 720 cars, 1¾ to 3½ cubic yards' capacity, 1 70-horse-power hoisting engine and 1 50-horse-power hoisting engine.

A day-labor force under the direction of the engineering force performed the following work: The water in Oakdale mill-pond was lowered, the gate repaired, and drainage ditches were dug where needed in the bottom of the pond. The gates and dam at the Clarendon Mills have also been cared for, and the drainage ditches along the margin of the reservoir have been maintained. About 115 acres of the reservoir site, including a strip 50 feet wide along the shore, have been cleared. The small trees and shrubs that have sprung up on the area from which the soil has been removed have been pulled or grubbed, and the brush has been mowed on the 50-foot strip along the shore of the reservoir where it had previously been cleared.

The maximum force employed on such work was 35 men and 1 horse, for the week ending July 20, 1901.

In addition to the engineering work connected with the estimates and inspection of the removal of soil, the following work has been done: For the guidance of the inspectors, the organic matter in 594 samples of soil has been determined, as well as the rate of filtration through 20 samples. The limit of area from which soil is to be removed along the margin of the reservoir has been staked out for 7.9 miles. Preliminary estimates of cost, plans, specifications and contract drawings were made for Contract No. 210. Topographical surveys and plans have been made of 87 acres of shallow flowage and steep slopes along the margins of the reservoir, and many cross-sections have been taken and plotted. The proper treatment of the shallow flowage and steep slopes has been studied. There have been 191 construction benches established.

CONTRACTS, WACHUSETT RESERVOIR.

Contract 166, Nawn & Brock.

Excavating Soil from Section 6 of the Wachusett Reservoir and building the Easterly Portion of the North Dike, Boylston, Clinton and West Boylston

On June 13, 1899, a contract was made with Nawn & Brock for completing the easterly portion of the North Dike, with the exception of the slope paving. The material for this purpose, with the exception of comparatively small amounts of sand and gravel, was to be obtained by removing the soil from some 1,700 acres known as Section 6 of the Wachusett Reservoir. By far the greater part of this section is located west of the South Clinton station and south of the Central Massachusetts Railroad. There is, however, a large area included in the section north and east of the South Clinton station, and a small area, comprising the bed of Coachlace Pond, south of the dike. The last-mentioned areas were sublet in 1899, but the subcontract was terminated on August 20, 1901, and the work was continued by the principal contractors.

Before beginning the removal of soil in the spring the subcontractors laid tracks upon which the soil could be hauled by locomotives to the dike, and all of the soil removed by them was hauled over this railway instead of up the incline used the previous year; otherwise there was no material change in the method of doing the work up to the time when the work was taken under the control of the principal contractors.

The principal contractors have prosecuted their work during the year in substantially the same manner as formerly, hauling the soil from all areas up their double-track railway to the dike. On the intervale and other low and comparatively level areas, where it has been practicable to do so, the contractors have loaded the soil directly into cars, throwing the track as the work progressed. On other portions of the work, where this method was impracticable, it was hauled to dumping platforms and there dumped into cars. The soil has been deposited in the easterly portion of the dike.

The total number of carloads hauled during the year from the area south of the Central Massachusetts Railroad has been 227,947, amounting to 750,744 cubic yards; this, with the 325,598 carloads hauled during the previous years, amounting to 1,126,719 cubic yards, makes a total of 553,545 carloads, amounting to 1,877,463 cubic yards.

The total number of carloads hauled during the year from the area north of the Central Massachusetts Railroad has been 69,468, amounting to 205,664 cubic yards; this, with the 42,045 carloads hauled during the previous years, amounting to 98,520 cubic yards, makes a total of 111,513 carloads, amounting to 304,184 cubic yards.

Earth, consisting of either sand or gravel, has been deposited as needed to construct an embankment on the water side of the dike, with a thick gravel facing on the water slope; also to complete the secondary embankment which forms a part of the dike further to the north. There have been 28,344 cubic yards of earth and 356 cubic yards of gravel used for this purpose during the year, which, added to 16,906 cubic yards of earth and 780 cubic yards of gravel used in previous years, make totals at the end of the year of 45,250 and 1,136 cubic yards, respectively.

There have been 1,575 cubic yards of earth deposited as a covering over muck which was so deep that it was deemed inadvisable to excavate it; this amount, added to the 167 cubic yards used for a similar purpose in previous years, makes a total of 1,742 cubic yards.

The plant used by the principal contractors after they assumed the entire work included 18 8 to 16 ton locomotives, 500 3½ cubic yard dump cars, 20 1.7 cubic yard dump cars and 20.6 miles of 3-foot-gage track.

The total amount of work done under this contract has been: —

	To December 31, 1900.	For the Year 1901.	Total to December 31, 1901.
Clearing and grubbing (acres), . . .	351	272	623
Soil excavation (cubic yards), . . .	1,249,545	957,108	2,206,653
Earth excavation (cubic yards), . . .	17,201	29,919	47,120
Gravel excavation (cubic yards), . . .	780	356	1,136

The maximum force employed was 980 men and 108 horses, for the week ending August 17, 1901.

Contract 183, Long & Little.

Excavating Soil from Section 7 of the Wachusett Reservoir, and building a Part of the Westerly Portion of the North Dike, Clinton and Boylston.

This contract was made on December 12, 1899, and called for the excavation of soil from about 313 acres of the Wachusett Reservoir site, known as Section 7, embracing the intervale north of the Central Massachusetts Railroad, the steep slopes on the northerly side of the intervale between South Clinton and Sawyer's Mills, the intervale and slopes on both sides of Cunningham's Brook, and a portion of the Catholic Cemetery in Clinton. The contract also provides for the completion, with the exception of the slope paving, of the northeasterly 2,400 feet of the westerly portion of the North Dike, the completion of the main embankment of sand and gravel, and the partial construction of the soil embankment for an additional 1,700 feet.

The entire work between South Clinton and Sawyer's Mills has been completed, and the use of the incline and hoisting engine for hauling the soil to the top of the bluff, midway between South Clinton and Sawyer's Mills, has been abandoned. Of the northeasterly part of the dike, 1,200 feet have been completed.

The plant employed, exclusive of horses and carts, has included 1 50-horse-power hoisting engine, 4 12 to 15 ton locomotives, 100 2½ cubic yard dump cars and 3.4 miles of 3-foot-gage track.

The soil along Cunningham's Brook and in the Catholic Cemetery has been removed partly by the car plant and partly by a force working with dump carts. On this section no soil has been hauled to dumping platforms and dumped into cars, as the carts have transported the soil directly to the dike, except a small amount which has been loaded into carts and dumped along the sides of the track and subsequently reshovelled into cars. On the steep slopes between South Clinton and Sawyer's Mills wooden chutes or troughs lined with sheet iron were used, the laborers shovelling the soil directly into the chutes, where it would slide to the track at the bottom of the slope.

During the year the car plant has removed 74,266 carloads of soil, containing 205,543 cubic yards; during the previous year 63,563 carloads, containing 176,587 cubic yards; making a total at the end of 1901 of 137,829 carloads, containing 382,130 cubic yards of soil.

There have been 28,710 cubic yards of earth used to cover deep muck during the year, and 1,700 cubic yards in the previous year, making a total at the end of 1901 of 30,410 cubic yards. A small amount of gravel for facing the dike was excavated from a pit south of the cemetery ridge, but, as the gravel proved unsatisfactory, a new pit was opened between Sandy Pond and the cemetery. Most of this gravel was taken to the dike with trains.

The total amount of work done under this contract has been: —

	To December 31, 1900.	For the Year 1901.	Total to December 31, 1901.
Clearing and grubbing (acres), . . .	46	90	136
Soil excavation (cubic yards), . . .	227,679	252,264	479,943
Earth excavation (cubic yards), . . .	1,864	28,710	30,574
Gravel excavation (cubic yards), . . .	655	26,930	27,585

The maximum force employed was 308 men and 49 horses, for the week ending May 18, 1901.

Contract 210, Newell & Snowling Construction Company.

Excavating Soil from Section 8 of the Wachusett Reservoir, and building a Part of the Westerly Portion of the North Dike, Clinton and Sterling.

On August 1, 1901, a contract was made with the Newell & Snowling Construction Company for removing soil from Section 8 to complete the westerly portion of the North Dike. This contract called for the removal of a sufficient amount of soil to complete the westerly portion of the North Dike, estimated to be 935,000 cubic yards. The area from which the soil was to be removed embraced about 550 acres, of which 410 acres required clearing and grubbing, and included all the territory north of the river below Sawyer's Mills, not included in previous contracts, and a considerable tract at and above Sawyer's Mills north of the Central Massachusetts Railroad. The contract also provided for the excavation of about 77,000 cubic yards of earth and gravel for the completion of the embankment along the water slope of the dike, and for covering deep muck which it was not considered desirable to remove.

Work under this contract was commenced on August 5. The material nearest the dike is hauled to the dike in carts, and that from a greater distance in cars. Most of the material removed in cars has been taken from the intervale above Sawyer's Mills, where it is loaded directly into the cars, hauled by a locomotive to the foot of an incline having a grade of ten per cent. near the West Boylston Road above Sawyer's Mills, thence hauled up the incline by a stationary hoisting engine, and from the top of the incline to the dike by locomotives.

The operation of the railway and car plant was begun October 16, and between that date and the end of the year 15,830 carloads, equal to 51,747 cubic yards, of soil were hauled to the dike. The car plant consists of 3 12-ton locomotives, 100 3 cubic yard dump cars, 1 70-horse-power hoisting engine and 3.3 miles of 3-foot-gage track.

The total amount of work done under this contract has been: —

Clearing and grubbing (acres), ...	54
Soil excavation (cubic yards), ...	100,553
Earth excavation (cubic yards), ...	10,600

The maximum force employed was 189 men and 33 horses, for the week ending November 9, 1901.

LAND SURVEYS.

Surveys have been made of the portion of Sterling west of the Stillwater River, referred to in chapter 445 of the Acts of the year 1897, also a plan of this land on a scale of 500 feet to an inch. Considerable additional work has been done in revising real estate plans, setting stone monuments and preparing plans for the use of the Attorney-General in land suits.

REAL ESTATE, CARE AND DISPOSAL.

Rents have been collected on houses in the possession of the Board, and a considerable quantity of land products have been sold. Fences and stone walls have been built and repaired. Trees and bushes have been cleared for 34,000 linear feet along the margins of the land purchased by the Board for a fire guard; interior cart roads 15 feet wide have been cut out for 21,150 linear feet; and the brush has been mowed on the fire guards and cart roads previously cleared. During periods of drought, watchmen have patrolled the land to guard against fires. There have been 123 acres of woods and brush thinned for the improvement of the existing growth. The necessary clearing has been done on 103 acres, preparatory to tree planting the coming spring; 1½ acres have been cleared and grubbed for extending the nurseries on the south side of the reservoir; making the total area of tree nurseries under cultivation about 5 acres, on 2 acres of which white pine seeds have been planted during the year. These nurseries contained at the end of the year approximately the following: —

	Seedlings.
White pines from seeds planted in 1898,	100,000
White pines from seeds planted in 1899,	70,000
White pines from seeds planted in 1901,	515,000
Total,	685,000

In West Boylston 53 dwellings, 14 barns, 2 mills, 1 hotel and 1 hall, making a total of 71 buildings, have been torn down or removed during the year; this makes a total of 150 to the end of the year. Considerable work has been done in repairing buildings which it is desirable to retain.

SANITARY INSPECTION.

The site of the Wachusett Reservoir has been carefully cared for by the sanitary and medical inspectors during the year. The general health of the public residing on the Wachusett watershed and of the laborers within the site of the reservoir has been good. There have been only a few cases of contagious diseases; of these, only 11 have been typhoid fever, 2 of these proving fatal. The cases were distributed as follows: 2 in Princeton, 2 in Sterling, 1 in Holden, 5 in Boylston and 1 in Clinton. Of these, the 2 in Princeton were imported cases. In West Boylston 8 cases of direct or indirect pollution of the water supply from house drainage have been remedied. On the watershed above Oakdale 5 cases of pollution from factory wastes and 5 from privy wastes have been corrected.

The board of health of the town of Holden has required the shoddy manufacturers to collect and burn up the waste rags and other refuse around their mills.

At four of the summer hotels in Holden and Princeton cesspools have been dug and the house drainage diverted into them. Twelve cesspools have been built at houses owned by the board.

The owner of two three-tenement houses in Boylston, built upon the watershed since the taking of the water of the river, failed to comply with the rules and regulations of the State Board of Health with regard to the discharge of house drainage where it would tend to pollute the water supply, and was brought into court and ordered by the judge to change his method of disposing of the house wastes so that they would not contaminate the supply. He has complied with the order by the construction of a cemented cesspool, which will, however, require frequent emptying.

The watershed of the river above Clinton has been divided into 13 districts by following the natural drainage lines of the brooks. From information already collected by the Board, supplemented by the new Worcester County atlas, a plan of each district has been drawn, showing the roads, brooks and houses. A field inspection to check these plans and to gather statistics in regard to population, sources of pollution and other similar information, is in progress. This inspection has been completed on the French Brook and Muddy Brook districts. The French Brook district contains a population of 380 people, with 76 horses and 270 head of cattle; Muddy Brook district, 123 people, with 41 horses and 215 head of cattle.

REMOVAL OF BODIES FROM ST. JOHN'S CATHOLIC CEMETERY.

As the work of excavating progressed at the cemetery, 30 additional bodies were found, and upon notification they were removed by representatives of the Cemetery Association. This makes a total of 3,872 bodies removed from the cemetery.

ENGINEERING.

In addition to the engineering work already enumerated and that necessarily connected with the contract and day-labor work in progress, the engineering force of the Reservoir Department has performed the following work: Levels of the ground at the Wachusett Reservoir, taken after the completion of the excavation, have been entered on the record sheets, and contour lines have been drawn covering an area of about 770 acres, making the total area of these final records at the end of the year 920 acres; measurements have been made from these sheets covering an area of 530 acres, for the purpose of determining the capacity of the reservoir; surveys, plans, estimates and cross-sections of proposed railroad changes at Oakdale have been made; gage readings have been taken at the storage reservoirs on the Wachusett watershed on the 1st and 15th of each month, and the storage at each date has been computed. Many tables and schedules have been prepared for the hearings before committees of the Legislature and before the special commission relative to compensation for the towns of Clinton, Holden and Sterling, and other lists have been made to determine the amount to be paid by the Board for taxes or in lieu of taxes to the towns of Clinton, Boylston and West Boylston. Much other work of a miscellaneous character has been done.

DAM AND AQUEDUCT DEPARTMENT.

T. F. RICHARDSON, *Department Engineer.*

The principal work in this department has been the construction of the Wachusett Dam, but early in June negotiations relative to the relocation of the Central Massachusetts Railroad reached a stage which warranted placing a force in the field to make the more accurate surveys required as a basis for constructing the road. The department also has charge of the maintenance and operation of the Wachusett Aqueduct and the Clinton Sewerage System.

The organization of the force has been modified by the transfer of Alexander E. Kastl, division engineer, from the Reservoir Department to this department, to take charge of the railroad surveys, and by the organization by transfer and otherwise of a party for this work. Chester W. Smith, assistant engineer, continued in charge of work at the Wachusett Dam. Ernest G. Hopson resigned his position as head draftsman at the Clinton office on June 6, to go into private practice; and, as the work in the drafting office had diminished somewhat, his place has not been filled. Elliot R. B. Allardice has continued in charge of the river and aqueduct gagings, and has the direct supervision of the maintenance of the Clinton sewerage plant.

The engineering force at the beginning of the year was 16, it reached a maximum of 26 in September, and at the end of the year numbered 21.

The main office of this department is in Clinton, and a branch office has been maintained near the Wachusett Dam.

WACHUSETT DAM.

The Wachusett Dam and the main contract for its construction, made on October 1, 1900, with the McArthur Brothers Company of Chicago, Ill., were fully described in the last annual report.

The contractor began work on October 11, and at the end of the year had done a large amount of work in installing plant, had excavated a small amount of material at the dam and had done considerable work in stripping at the quarry, 1¼ miles from the dam.

Plant.

At the beginning of the year work upon the compressor plant and cableways was in progress, and one cableway across the valley had been erected. On January 26 a second cableway, of the same dimensions and capacity as the first, was completed and put in operation.

Compressors and the pipes leading from them to the dam and quarry were finished early in April, and the power was first used at the quarry on April 13 and at the dam on April 18. Since these dates practically all of the machinery at both places, including cableways, derricks, pumps, drills, etc., has been operated by compressed air.

The compressor plant, which is located at the side of the Central Massachusetts Railroad, between the quarry and the dam, consists of two cross-compound Rand air compressors, which are operated by two compound condensing Corliss engines, rated at 500 horse-power each. The diameters of the steam cylinders are 18 inches and 34 inches, and of the air cylinders 20 inches and 34 inches; the length of the stroke is 42 inches. The two boilers which supply the steam are Cahall inclined water tube boilers, made by the Aultman & Taylor Machinery Company of Mansfield, O.

To supply the large quantity of water needed for cooling, condensing, etc., a 3-inch pipe line, about 3,550 feet long, has been laid from Clamshell Pond, which has an area of about 26 acres and an elevation sufficient to supply water to the inter-coolers of the compressors. To economize water as far as possible, the waste water is discharged into the far side of a reservoir several acres in extent, and after passing through this reservoir is again pumped to be used for cooling and condensing purposes. The main wrought-iron air pipe leading to the dam is 8 inches in diameter, and that leading to the quarry 6 inches in diameter.

From the time of starting until November 23, when night work was stopped for the season, the compressors were in operation day and night. The amount of power furnished has varied considerably, but has averaged about 600 horse-power for day shifts and about 370 horse-power for night shifts. The maximum amount used at any time was 850 horse-power.

A branch track, 5,490 feet long, from the Central Massachusetts Railroad to the dam site, was built in 1900. A part of this track serves as the main track from the quarry to the dam, but it was necessary to build an additional 3,030 feet, which was completed early in April. To carry this extension over the Central Massachusetts Railroad and Boylston Street, where there is an electric car line, a pile bridge about 800 feet long and having a maximum height of about 32 feet was built.

In order to get more working room at the quarry at a level about 40 feet higher than the first opening, a double switch-back track, about 3,300 feet long, was built, connecting the upper with the lower quarry; this was completed and put in operation late in August.

The main pumps at the dam were two 12-inch Worthington compound piston pumps, set on the up-stream and down-stream sides of the deep excavation for the dam, and most of the time the water was pumped into the large flume. These two pumps were capable of pumping all of the water which came into the excavation, but supplementary pumps were provided for emergencies and additional small pumps for pumping from the cut-off trench and for other local pumping.

To supply water for the use of the locomotive, mortar mixing, washing the rock foundation of the dam preparatory to building masonry, and other purposes, water has been pumped from the river to a tank 92 feet above it on the hillside; and to supply water for washing stones at the quarry, a pump at the central power station raises the water about 200 feet to a tank on the hill near the quarry, this tank being 152 feet above the track in the lower quarry.

A 60-ton, 10-wheel, standard-gage locomotive, 29 flat and gondola cars and 4 4-yard dump cars are used to haul stone and other material. In addition, there are 15 3-foot gage 2½ yard cars, which are used for various purposes.

A maximum of 8 derricks has been in operation at the dam and 8 at the quarry. Those at the quarry are unusually large, some of them having masts 82 feet high. The derricks at the quarry are operated by hoisting engines having 7 by 10 inch cylinders, and those at the dam by hoisting engines having 5½ by 8 inch cylinders. All of the derricks are equipped with bull wheels, by means of which the engineer swings the derrick, doing away with the use of tagmen.

The arrangements for supplying and mixing the materials used for mortar have been carefully made, with reference to economy in operation. Two cement storehouses, which have a capacity of 4,500 barrels, are situated near the head towers of the cableways, and close to the branch track over which the cement is brought. The sand bin, which has a capacity of 370 cubic yards, is located further up the hill, and so constructed that the sand will run into small cars on either of two tracks which pass under the bin. The sand track passes between the cement houses, above the level of the tops of the doors, and the sand can be dumped directly into a cubical mortar mixer 4 feet on a side, which has been installed immediately below the space between the cement houses. The cement can be wheeled from either cement house and dumped from a platform into the mixer. The mortar after being mixed is dumped into skips placed on small cars on a lower track, which are hauled by horses directly under the cableways and delivered by them upon the work.

To accommodate the better class of unmarried laborers, three large buildings have been built; two of these are for sleeping quarters, — each of which will accommodate nearly 80 men, — and the other contains a kitchen and dining room. For sleeping quarters the buildings are divided into small rooms, which are furnished with iron beds and mattresses, and at one end of each a recreation room is provided and at the other end bath tubs with hot and cold water. Many small buildings have been built to accommodate men with families; and an office, machine shop, storehouse, commissary and other small buildings have been erected.

Quarry.

In the early part of the year the work of stripping the quarry was in progress, and during the latter part of February a travelling derrick was erected to handle the rock excavated and to prepare a working face. Derricks with guys were installed as soon as a sufficient face had been obtained.

Early in June, when it was found that the poor quality of the rock at the far end of the quarry made it inadvisable to extend it in that direction, a second quarry opening was started, at a level 40 feet higher than the first. Five derricks have been in operation at the lower quarry, which it is intended to work from the level of the upper quarry down to a point 30 feet below the track. At the close of the season three derricks were in operation at the upper quarry, and work was in progress which would permit the placing of more derricks.

The stone obtained at the quarry is a muscovite granite, weighing 165 pounds per cubic foot, of good quality for splitting and cutting, and having substantially the same crushing strength as the Cape Ann and Quincy granites. All of the stone for rubble masonry and all of the ashlar used up to the present time have been obtained from this quarry.

Both large and small stones suitable for use in the masonry are loaded directly into large skips or scale boxes, placed upon flat cars, which are made into trains and hauled to the dam directly beneath the cableways; the skips are then lifted by the cableways and lowered to the point where the masonry is in progress. The average skipload of large stones equals about 2.3 cubic yards, and of spalls 1.9 cubic yards, solid measure.

Excavation at Dam.

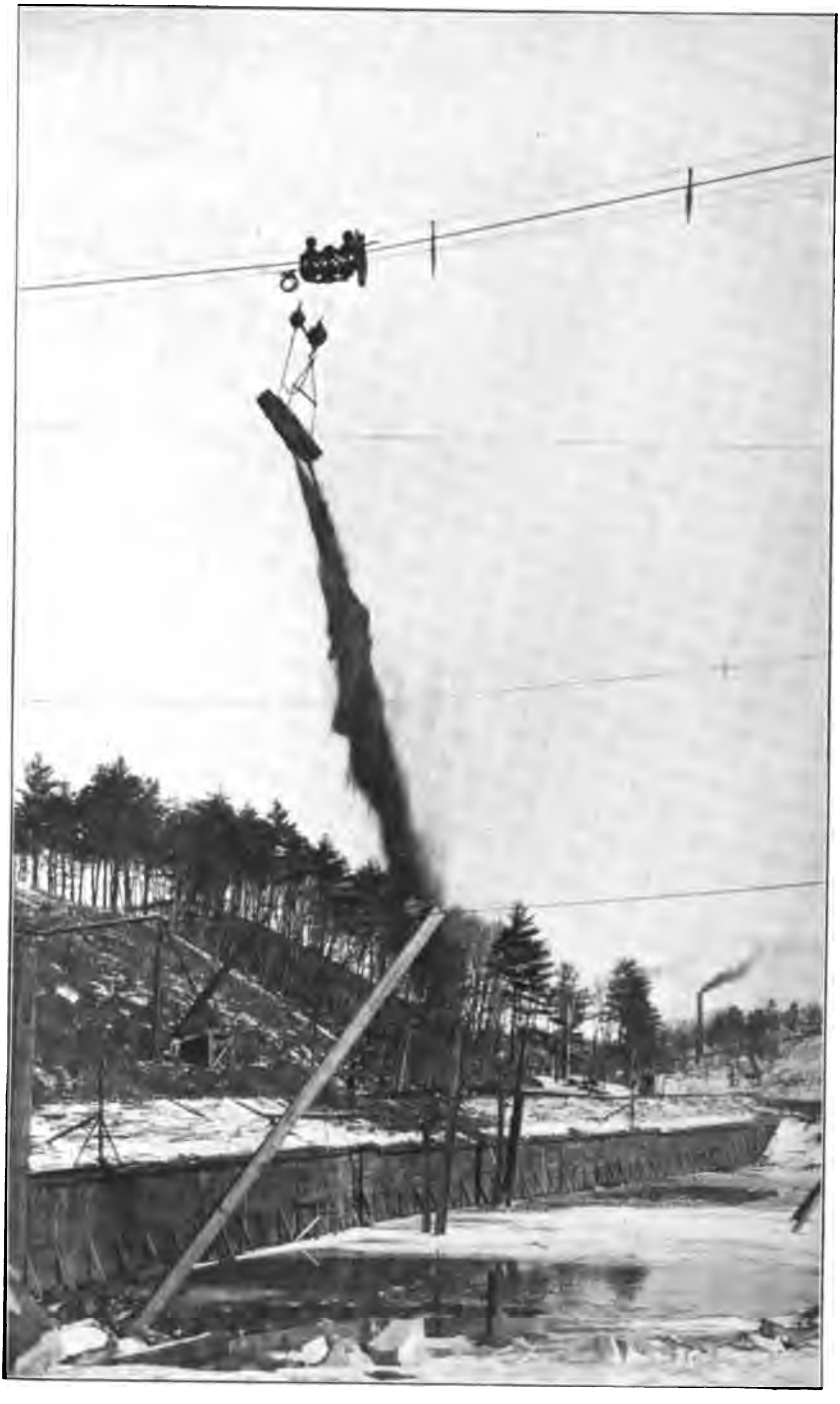
At the beginning of the year one cableway was in operation, removing material from the deep excavation in the bottom of the valley. Late in January, when the second cableway was put in operation, the force was increased. On February 28, night shifts were organized, fourteen electric arc lights being provided to light the work. The excavation was continued with day and night shifts until June 8, soon after the masonry was started, and since that time most of the excavation has been done by the night shifts.

The material for about 30 feet below the bed of the river was sand and gravel, which was easily handled. Below this level, from a large part of the area for rather more than 20 feet to the ledge, boulders, large and small, packed very close together, with the interstices filled with cemented gravel, were encountered. This condition made the excavation somewhat difficult. Some of the boulders were of enormous size, one containing 621 cubic yards.

The earth excavation was started with slopes of 1½ horizontal to 1 vertical, and continued with this slope to the bottom on the up-stream side; but on the down-stream side the boulders and cemented gravel were so firm that the lower part of the excavation was made nearly vertical. The slopes were laid out so that they would intercept the surface of the rock 20 feet above the up-stream face of the masonry, and generally 15 feet from the down-stream face. The maximum width of the excavation at the top of the pit was 376 feet, and at the surface of the ledge 211 feet. The maximum amount of water pumped was about 4,000,000 gallons per day. There was some caving of the up-stream slope, which was composed largely of sand; but this was treated when it occurred, so that the slopes were maintained without much difficulty, and the whole excavation was completed without accident or serious delay.

As the earth excavation progressed, the granite cliff about 40 feet high on the westerly side of the gorge was uncovered and found to be overhanging, as indicated by the preliminary borings. The overhanging part and some additional rock were removed by blasting. At one point it was necessary to blast to a distance of 30 feet back from the face of the cliff.

The ledge rock in the bottom and on the easterly side of the gorge is schist, sometimes gray and quite hard, and at other places black



WACHUSETT DAM—FILLING ABOVE DAM IN WINTER BY CABLEWAY.

UNIV. OF MICH.

and rather soft, but impervious to water. The schist at the contact with the granite, for a varying width, ranged from about 4 feet at the cut-off, where it is quite soft, to a maximum of about 20 feet, where it is somewhat harder; but the junction with the granite seemed to be a perfect one in nearly all cases, and the schist is water-tight and sufficiently strong to resist any pressures which may come upon it.

After reaching the rock, the excavation was continued as far as necessary to obtain solid rock nearly free from seams. The average depth of excavation in the rock has been about 13 feet, and the cut-off trench, 20 feet in width, has been excavated to an additional depth of about 14 feet. In order not to disturb the walls of the cut-off trench, lines of 3-inch holes, 6 inches apart on centres, were drilled to the bottom of the trench; the rock in the centre of the cut-off was then removed by careful blasting, and large steel wedges were used in the side holes to remove the rock near the walls of the cut-off. By this method of operating, the walls were generally left vertical and were not shattered.

A deep recess, about 20 feet in width, was cut into the face of the granite cliff, with considerable difficulty and delay, by the same methods.

Under the provisions of the specifications the last part of the rock excavation before building the masonry was to be done by barring and wedging, without blasting. In this way all loose or shaky rock was removed, the average depth of such excavation being about 1.5 feet. The rock was then scrubbed with brooms and thoroughly washed with water.

The excavated material was removed by the cableways, and was used in part for grading the grounds on the westerly hillside near the bastion, where a considerable fill is to be made, but most of it was placed on cars and dumped along the quarry track.

Considerable earth was excavated from the site of the power house, pool and conduits, and used to refill the deep excavation on the down-stream side of the dam, after the masonry had risen high enough to permit this to be done. Some of the material excavated from the site of the dam has also been dumped at this place, and the filling has been raised nearly to the level of the top of the masonry.

At the end of the year, after work upon the masonry had been stopped, earth excavation was in progress in the waste channel and in the trench for the dam on the westerly side of the large flume. The material from the place last named was dumped on the up-stream side of the dam, between a filling of clayey material previously made against the up-stream face of the masonry and the slopes of the deep excavation.

Masonry.

The first stone at the dam was set June 5, and the building of the masonry was continued until December 3, when it was stopped on account of the cold weather. The largest number of derricks in operation has been 7 on the masonry of the dam and 1 on the masonry of the spillway below the pool.

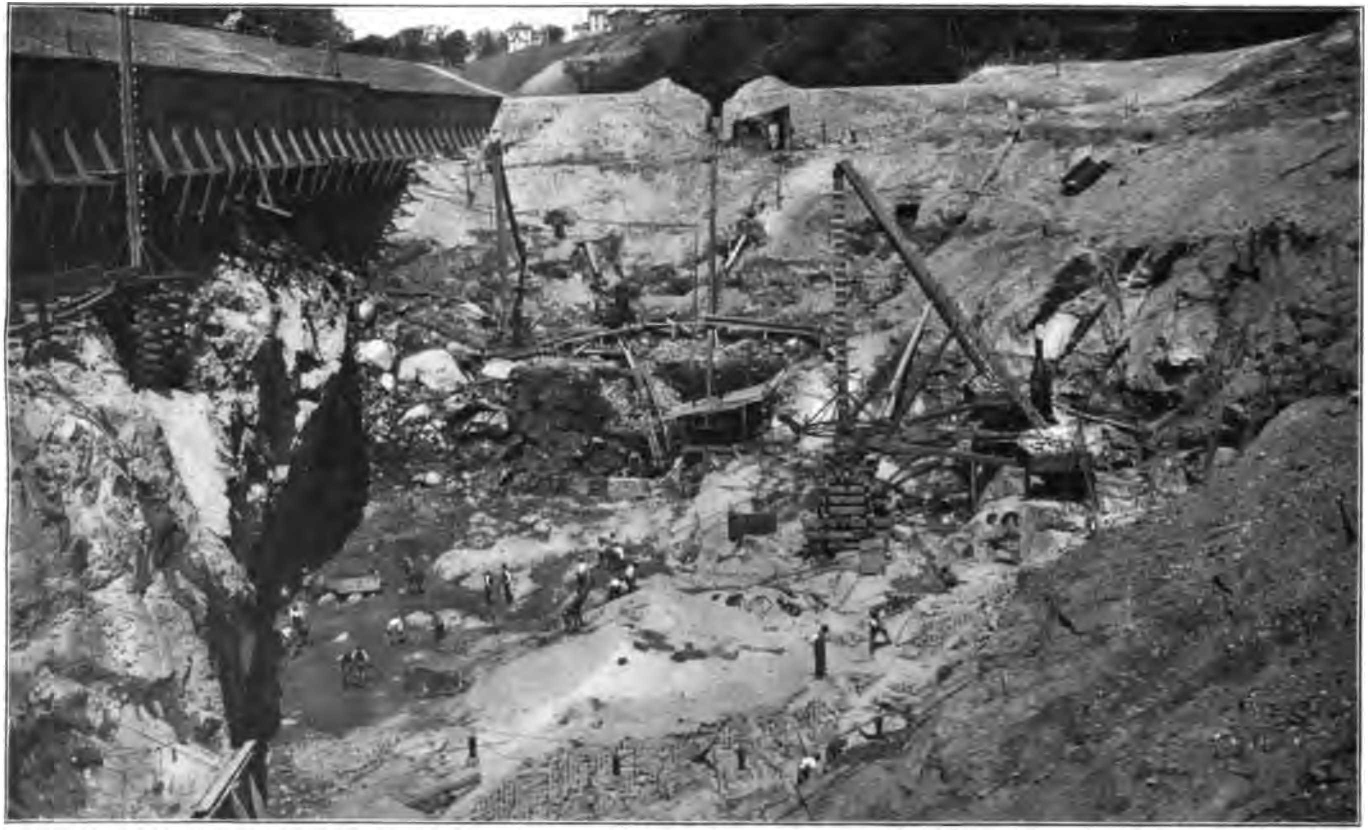
Masonry used for filling the cut-off and that immediately above the rock over the whole foundation of the dam has been laid in Portland cement mortar, mixed in the proportion of 2 parts of sand to 1 of cement. The use of Portland cement has been continued to greater heights, so as to include all masonry in a triangular section below an inclined line 50 feet above the bottom of the gorge at the down-stream face of the dam, and intersecting the bottom of the gorge 150 feet up stream from the lower edge of the dam. After leaving the bottom of the excavation, however, the Portland cement mortar was generally mixed in the proportion of 2½ parts of sand to 1 of cement.

Above the limits of the Portland cement work natural cement mortar has been used, mixed in the proportion of 2 parts of sand to 1 of cement, except that toward the close of the season, when the work might be affected by frost, Portland cement mortar, mixed in the proportion of 3 parts of sand to 1 of cement, was used.

In all, 17,703 barrels of Giant Portland cement and 8,892 barrels of Union natural cement have been used in the work, both brands of cement being manufactured by the American Cement Company of Egypt, Pa.

The stone in the triangular section of the dam, where Portland cement was used, was laid with beds inclined upward toward the down-stream face of the dam at the rate of 1 vertical to 4 horizontal. Above this section the stones in the down-stream half of the dam have had their beds inclined upward at the rate of 1 vertical to 6 horizontal.

On the down-stream side of the dam, where there was a vertical



WACHUSETT DAM—EXCAVATION AT TIME OF BEGINNING MASONRY CONSTRUCTION.

UNIV. OF MICH.

face of large boulders and cemented gravel which was very firm indeed, and where the granite cliff was overhanging, masonry laid in natural cement mortar was filled in against the cliff and between the down-stream face of the dam and the boulders and cemented gravel to a height of 28 feet, close to the granite cliff, and a diminishing height as the distance from the cliff increased. This filling was made for the double purpose of supporting the overhanging cliff, which farther up stream would have the weight of a portion of the dam upon it, and in part to furnish a solid buttress which would resist any tendency of the dam to slide upon its foundation. The area of this buttress, where in contact with the boulders and cemented gravel, was about 830 square feet.

In all cases where there was any advantage in doing so, the masonry at the down-stream face of the dam was built out against the sides of the rock excavation. In laying the stones, great care has been taken to fill every joint between the stones with mortar, and spalls have been used to fill between the large stones to the greatest extent consistent with the proper bedding of the stones.

The masonry of the dam as far as built is made up of 54 per cent. in volume of large stones, 17 per cent. of spalls and 29 per cent. of mortar. The average size of the stones used has been quite large, some containing as much as 3 cubic yards.

The up-stream face of the dam has been built of squared stones, having joints not wider than 1 inch, and these joints have been raked out for 2 inches back from the face and pointed with mortar composed of 1 part of Portland cement and 1 part of sand.

The down-stream face of the dam is in irregular steps, the inner angles of which conform to the required slope of the face.

The largest amount of masonry laid in the dam in any week was during the week ending October 12, when 7 derricks were in operation and 1,767 cubic yards of masonry were laid.

Following are some elevations, which will give an idea of what has been and what remains to be done: —

	Feet.
Elevation of lowest point in cut-off trench,	187
Elevation of bottom of masonry in deepest part of gorge, not in cut-off trench,	208
Elevation of top of masonry built,	255
Elevation of bottom of river channel,	269
Elevation of bottom of pipes through dam,	284
Elevation of top of dam,	415

A part of the rubble masonry and of the ashlar paving of the apron below the spillway has been built. Some of the paving stones are about 8 feet long and 4 feet deep, and contain over 60 cubic feet.

Excellent sand has been obtained from land of the Commonwealth, about 3/8 mile from the dam, to which it is hauled by teams.

Mortar has been mixed in the cubical mixer in batches of about 1 cubic yard, which, in the case of a 2-to-1 mixture, requires about 3½ barrels of cement and 7 barrels of sand. Two batches are usually dumped into a skip and sent down upon the work together.

Comparison of Work Done with Total Amount.

The following table gives the total quantity of work done to the end of the year and the estimated total quantities: —

	Work done December 31, 1901.	Total Work.
Earth excavation (cubic yards), ...	43,000	267,300
Rock excavation (cubic yards), ...	24,370	100,000
Rubble stone masonry (cubic yards), ...	28,486	265,000
Ashlar masonry (cubic yards), ...	65	10,300
Dimension stone masonry (cubic yards), ...	-	2,900
Brick masonry (cubic yards), ...	-	1,300
Concrete masonry (cubic yards), ...	-	8,300

The above statement does not represent fairly the relation between the work done and the total work, because of the great amount of work done in installing the plant, opening the quarry and organizing the work; moreover, the most difficult part of the work has been accomplished.

The maximum force employed by the contractor has been 344 men and 22 horses, for the week ending July 20, 1901.

MORTAR EXPERIMENTS.

In view of the very large amount of mortar to be used in the dam and the importance of having it as water-tight and strong as possible, extensive experiments were begun early in the year, to determine the permeability and strength of mortars made of the natural and Portland cements which were to be used in the construction of the dam, mixed with different proportions of coarse and fine sands.

The experiments on permeability were made by placing the mortar in cast-iron cylinders, 22 inches long and about 6 inches in diameter. After the mortar had set, caps were bolted to the tops of the cylinders and water was admitted to the cylinders between the caps and the mortar with a pressure of 74 pounds to the square inch. There were 144 cylinders used in the experiments, and the apparatus was so arranged that the water pressure could be applied to 24 cylinders at a time. The applied water was first filtered through sand, to remove all suspended matter.

There were 1,494 briquettes made and broken, to determine the tensile strength of the mortars. It was found that the use of a sand with a very large proportion of coarse particles and a much smaller percentage of the finer grades makes a mortar both less permeable and stronger than where a larger proportion of the finer grades is used, provided the proportion of sand to cement does not exceed 3 to 1.

In addition to the experiments upon permeability and strength of mortars, other experiments were made to determine the relative strength of mortars used immediately after wetting and mixing, and when used at different intervals up to two hours after they are first wet and mixed. These experiments were very extended, as they were made with mortar mixed with different grades of sand, with Portland and natural cement, with slow-setting and quick-setting cement, and with mortar that was worked continuously from the time of mixing until it was put into the molds, and also with mortar which was not worked after it was mixed until just before it was put into the molds. The briquettes were broken at the end of fourteen days, twenty-eight days, and three months after mixing.

It was found that when the cements, both Portland and natural, were so manufactured as to take the initial set slowly, the strength of the mortar was not diminished by a delay of two hours in putting it into the molds; and when the mortar was worked continuously to the time of filling the molds, there was an increase in strength occasioned by the delay. When the cements were so manufactured as to take the initial set quickly, the results obtained with the Portland cement were not materially different from those obtained with the slow-setting cement, except that when the mortar was not worked there was a slight loss of strength in the briquettes molded at the end of one and a half and two hours, and at no time was there much gain in strength occasioned by delay in filling the molds. The results obtained with the quick-setting natural cement were less favorable, as the briquettes broken at the end of fourteen days showed a great loss of strength when there was much delay in molding the briquettes. At the end of three months, however, the briquettes made with mortar which had been worked continuously from the time of mixing showed slightly greater strength than that put into the molds immediately, and the loss of strength of the mortar not worked was not very marked except for the one and a half and two hour periods.

RELOCATION OF CENTRAL MASSACHUSETTS RAILROAD.

Beginning in June, a careful survey was made for a line of railroad, leaving the present track of the Central Massachusetts Railroad midway between the Berlin station and the crossing over the New York, New Haven & Hartford Railroad, curving to the north and running east of the New York, New Haven & Hartford Railroad to a junction with the Worcester, Nashua & Portland division of the Boston & Maine Railroad, about one mile north of Clinton. Much work was done in connection with the line surveyed, to prepare it for construction, because there was a strong probability that this line would be adopted. It has not, however, been adopted.

In the latter part of the year estimates of cost were made for two other lines, which pass north of the reservoir and connect with the Worcester, Nashua & Portland division.

GAGINGS OF THE SOUTH BRANCH OF THE NASHUA RIVER.

Accurate and continuous gagings of the South Branch of the Nashua River, at a point in Clinton about 1½ miles below the Wachusett Dam, have been made since July, 1896, but the results have not heretofore been published. Tables giving the results by months may be found in Appendix No. 3, tables 9 and 10.

The gagings are intended to show the quantity of water that would have flowed past the gaging station if no water had been diverted through the Wachusett Aqueduct, and for nearly all of the time the quantity that would have flowed if there had been no mill and other storage reservoirs upon the watershed.

As accurate gagings of streams are rare, it is thought desirable to describe in some detail the methods of measurement.

Gagings of Flow in River.

The quantity of water passing down the river bed has been gaged at a point near the Water Street bridge in Clinton. Just above this bridge there is an unused dam which has been partly demolished, but at which there is still a decided fall, so that the height of the water above it, when a given quantity of water is flowing, is affected but little if any, under all ordinary conditions, by the condition of the stream below the dam as regards obstructions from weeds in summer and ice in winter.

Above this dam a recording float gage was established, to give the height of the water accurately and continuously. Just below the dam and bridge a gaging section was established, having a plank bottom, and so arranged that the velocity is sufficient for accurate current meter gagings. When the flow of the river is very small, owing to the diversion of the water through the aqueduct, arrangements have been made to diminish the width of section through which the water flows, and thereby produce a sufficient depth and current for meter measurement.

By a sufficient number of meter measurements at all stages of the river, a curve was determined which showed the quantity of water corresponding to all heights on the recording gage. The relation between the quantity and the gaged height is frequently checked throughout the year.

The current meter used was originally rated, and the rating has since been checked from time to time at a well-arranged rating apparatus at Sandy Pond.

From July 1, 1896, when the gagings were begun, to July 15, 1896, the recording gage was not in operation, but an average of eight observations of height was made daily. In February, 1900, on account of a great flood which overflowed the bank of the river where the gage-house and gage were located, it became necessary to remove the gaging apparatus, and there were two days when the heights were not kept continuously throughout the twenty-four hours; otherwise, the recording gage has been in continuous operation.

Gagings of Flow in Aqueduct.

The first diversion of water from the river through the aqueduct was on March 7, 1898. At the lower end of the aqueduct a weir was established with a recording float gage, providing for a continuous record of the height of water flowing over the weir. A current meter station was established for gaging the flow through the aqueduct, and the weir was calibrated by many measurements with the current meter at various depths of flow. The quantity of water flowing through the aqueduct is, therefore, very accurately measured. In the lower stages of the river nearly all of the water passes through the aqueduct.

Storage Reservoirs.

There are upon the watershed 14 storage ponds and reservoirs, nearly all controlled by the mills, the capacities of which have been determined. The draft from these reservoirs materially increases the flow of the river in the drier portions of the year, and the flow diminishes while they are filling. These reservoirs, and their total capacities as determined by surveys, are as follows: —

NAME OF RESERVOIR.	Storage Capacity (Gallons).
Bartlett Pond,	48,400,000
Chaffin Pond,	99,600,000
North Eagle Lake,	48,400,000
South Eagle Lake,	192,000,000
Hackett's Pond,	27,600,000
Kendall Reservoir,	82,200,000
Musquapoag Pond,	61,900,000
Paradise Pond,	111,700,000
Pine Hill Reservoir,	118,700,000
Quinepoxet Pond,	275,600,000
Stuart's Pond,	58,800,000
East Waushacum Pond,	144,000,000
West Waushacum Pond, east of railroad,	170,000,000
West Waushacum Pond, west of railroad,	32,900,000
Total,	1,471,800,000

In addition to the above, there are some small ponds and reservoirs that were not surveyed, but their aggregate capacity is so small that they would not materially affect the flow in the river.

Observations of the heights of water in the reservoirs included in the table have been taken twice each month, usually on the 1st and 15th days, during the following periods: June 1 to November 15, 1897, inclusive; June 1 to November 1, 1898, inclusive; June 1, 1899, to January 15, 1900, inclusive; and continuously since June 1, 1900.

It will be noticed that no observations of the heights of reservoirs were taken in 1896, nor were any taken during the winter and spring months, until after the spring of 1900. The omission of the observations of the storage reservoirs in the summer and autumn of 1896 materially affects the records for that period; but the omission of observations in the winter and spring of several years causes little or no error, because at such times the reservoirs are usually full or nearly full, and the flow of the streams is comparatively large.

As already indicated, the aggregate quantity flowing in the river at the gaging station and in the aqueduct is corrected for the amount drawn from or added to storage, so that the records give as nearly as possible the actual flow of the river as it would be in its natural condition.

The change in storage during the month preceding and following the observed heights has been estimated; and during the remainder of the winter and spring months, when there were no observations, it has been assumed that the reservoirs were full.

Area of Watershed.

The area of the watershed above the Wachusett Dam was determined by the State Board of Health, from the topographical map of the State, after a careful reconnaissance of the divide for its whole length, to be 118.23 square miles. A change in the location of the North Dike from that originally proposed has added .08 of a square mile, and an additional area of .69 of a square mile, draining to the river between the Wachusett Dam and the gaging station, makes the total area of the watershed at the gaging station 119 square miles.

Real Estate, Care and Disposal.

Rents have been collected and repairs made on the houses belonging to the Board in the neighborhood of the dam and of the Clinton sewerage filter-beds in Lancaster.

Cement Tests.

Tables of cement tests are published in Appendix No. 2. They contain long-time tests of cements used from 1896 to 1900, inclusive, and the usual tests of cements used in the Wachusett Dam and the Weston Aqueduct in 1901.

SUDBURY DEPARTMENT.

Desmond FitzGerald, *Department Engineer.*

The work in this department relates mainly to the maintenance and operation of the Sudbury and Cochituate works, including the aqueducts and Chestnut Hill Reservoir.

The work of construction in this department during the year has been connected entirely with the improvement of certain shallow arms of Lake Cochituate, known as the Pegan Brook and Snake Brook meadows. This work was required by chapter 509 of the Acts of the year 1901, which was approved June 14. Mr. FitzGerald and his assistants have also devoted much time to the case of the Nashua River Paper Company *v.* Commonwealth of Massachusetts, for damages caused by the diversion of the waters of the Nashua River, and to other water cases.

Charles E. Haberstroh, assistant superintendent at South Framingham, is in immediate charge of the storage reservoirs and other works on the Sudbury and Cochituate watersheds and of the Sudbury and Cochituate aqueducts.

Charles W. Sherman, assistant engineer, is Mr. FitzGerald's principal assistant in the Boston office.

Benjamin F. Goodnough, assistant engineer, has been connected with the department all the year, and during the last half has been in immediate charge of the improvements at Lake Cochituate.

The engineering force engaged upon construction has varied from 1 to 5.

The main office of this department is in Boston, and a branch office has been maintained at South Framingham.

Improvement of Lake Cochituate.

Before the lake was raised above its original level the Pegan and Snake Brook meadows were comparatively dry, but by successive raisings of the water surface they were covered to a depth of about 6 feet when the lake was full. When the lake was drawn down, in times of drought, the mud surfaces were exposed, and at such times odors arose from decaying vegetation and from the exposure of the mud to the sun.

A plan for abating this trouble, and more particularly the trouble at the Pegan Meadow, was suggested by the engineers of the Metropolitan Water and Sewerage Board, in which it was proposed to maintain a dam at the outlet of the meadows which would have its top about 2 feet below the level of high water, so that the water from the lake could circulate freely into the portion of the lake behind the dam for several months of the year when the lake was full, and yet the dam would maintain a considerable depth of water over the meadows when the lake was drawn down, and thus prevent offensive conditions.

This plan, which would have cost but a few thousand dollars for its execution, was not satisfactory to the petitioners to the Legislature, and the act already mentioned was passed, providing for the excavation of the meadows to a level which would give practically 10 feet of water over them at high water.

The act further provided that the work should be done within two years from its passage; and that, in addition to the excavation of the meadow, the banks should be improved so that mud deposits should not be exposed thereon at low stages of the water; and that, if it should prove impossible to excavate the meadows to the specified depth for the sum of $100,000, the work should be prosecuted to such an extent "as may reasonably be done" for this sum.

The time for executing this work was extremely short, because it could be prosecuted only after the lake had been drawn down; and the rainfall during the last summer was so large that it soon became evident that it would not be feasible to improve more than the Snake Brook Meadow, which is the smaller one, during the year, although certain preliminary work could be done at the Pegan Brook Meadow, so that it could be pumped dry early in the summer of 1902 and completed in that year.

The plan of operation was rendered difficult because it was necessary to provide for taking care of large quantities of dirty and possibly polluted water without discharging it into the lake in such a way as to endanger the water supply.

The necessary surveys, soundings, plans and specifications were begun soon after the passage of the act; and as soon as the water in the lake had receded sufficiently, the work of construction was begun.

Snake Brook Meadow.

The arm of Lake Cochituate known as the Snake Brook Meadow covers an area of 28.7 acres, of which 17.5 acres are in the town of Wayland and 11.2 in the town of Natick. Plans having been prepared and the lake having receded sufficiently, it was decided on August 20 to proceed with the excavation of this meadow, with a view to completing it before the lake filled again. On the next day after this decision the actual work of construction began, in the building of a dam at the outlet of the meadow, to separate it from the main body of water in the lake. A 15-inch centrifugal pump was installed upon this dam, and on September 1 pumping from the meadow into the lake was begun. A 6-inch centrifugal pump was also erected to do the pumping after the meadow had been laid bare. To reduce the amount of water to be pumped, Snake Brook was diverted from its natural course at a point about half a mile easterly from the meadow. By the end of the first week in September the water had been lowered so that the meadow was exposed.

In response to a request for proposals for doing the work, eight proposals were received on September 10, and the contract was awarded to Long & Little of Leominster, Mass., the lowest bidders, at 24 cents per cubic yard for mud excavation and 25 cents per cubic yard for gravel facing. By the terms of the contract the Board was to continue to do the pumping, and was also to continue the work, already begun, of excavating main ditches through the meadow.

As the water to be pumped after the excavations were begun would necessarily be unfit to be discharged into the lake, a small wooden flume, about 1,060 feet in length, was provided for conducting the water pumped in a westerly direction, following a road across the lake, to a point where it would flow away from the lake into a stream below its outlet. A heavy rainfall of 2 inches on October 14 was cared for without flooding the contractors' work.

The work of ditching the bottom was carried on by a day-labor force, while the contractors were making their preparations. On September 30 the actual work of excavating the bottom was begun, with a small force, which was gradually increased to about 90 men on October 19.

As the amount of money available for making the improvements at Lake Cochituate was thought to be insufficient for excavating to the full depth required by the act, it was intended to excavate the

Snake Brook Meadow to a level 9 feet below high-water mark. The mud was everywhere excavated to this depth; but a sandy bottom was encountered at a somewhat higher level over a portion of the work, and this was not excavated. At the end of the year nearly all the excavation had been completed and the gravelling of the embankments had been begun. So little remains to be done that the work can probably be finished early in 1902, before the lake rises.

Pegan Brook Meadow.

The arm of Lake Cochituate known as Pegan Brook Meadow covers an area of 51.3 acres, and is situated in the town of Natick. The plan finally adopted for the improvement of this meadow involves the excavating of the meadow and the disposal of the material excavated in embankments to be faced with gravel, as at Snake Brook Meadow. As already stated, the amount of work involved was so great and the lake lowered so slowly that it was not feasible to attempt the main work in 1901, but much preliminary work has been done, so as to insure a long working season in 1902.

A temporary dam, about 700 feet in length, has been built at the site of an old dam, to separate the meadow from the lake. The top of this dam is above high-water mark, so that the meadow can be laid bare by pumping, even if the lake is full or nearly so after the spring freshets are over.

In addition to the building of the dam, a pump well about 10 feet square was sunk while the lake was low, near the line of the Boston & Albany Railroad, and a pump was erected to pump water during the work of construction through a 12-inch pipe under the railroad to filter-beds already in use in connection with the filtering of the waters of Pegan Brook.

The preliminary work at the Pegan Meadow was begun on September 28. In the last part of November, after the well and dam had been completed and nearly all of the meadow had been laid bare by the lowering of the lake, the stop-planks were placed in the sluiceway of the dam, and for the remainder of the year all water was pumped. As soon as the water had been lowered sufficiently, the actual work of constructing a large drainage ditch through the centre of the meadow was begun. On account of the heavy rainfalls in December the work was several times flooded, but at the end of the year was still under way. The water in the lake was then about 4 feet higher than the water inside the dam.

WESTON AQUEDUCT DEPARTMENT.

HORACE ROPES, *Department Engineer.*

The work in charge of this department includes the construction of the Weston Aqueduct and Reservoir and other works connected with it, extending from the Sudbury Reservoir in Southborough to a terminal chamber a short distance west of the Charles River in Weston, a distance of 13.44 miles.

At the beginning of the year the surveys and preliminary work necessary for the final location and design of this aqueduct and its appurtenances were still unfinished. The work of the year has included the substantial completion of these surveys, the letting of contracts and the construction of portions of the work.

The beginning of construction required a reorganization of the engineering force, as follows: —

Edward S. Larned, division engineer, transferred from the Sudbury Department to this department January 1, 1901, was placed in special charge of the masonry construction, with direct supervision of the inspection force and the cement-testing laboratory.

Four assistant engineers were assigned to divisions of the work, in charge of lines and grades, measurement of quantities and making estimates, and were given authority to direct in all matters pertaining to excavation and grading.

Dan B. Clark was placed in charge of the first division, comprising sections 1, 2, 3 and 4.

Frank E. Winsor was placed in charge of the second division, comprising sections 5, 6, 7, 8 and 9, and has also had charge of the drafting work at the main office in Saxonville.

Marshall Nevers was placed in charge of the third division, comprising sections 10, 11 and 12, and in the latter part of the year the westerly portion of Section 13.

George W. Booth was placed in charge of the fourth division, comprising sections 13, 14 and 15 and the Weston Reservoir, except the westerly portion of Section 13 during the latter part of the year.

All of the above engineers reported directly to the department engineer.

The total engineering force at the beginning of the year was 21, but with the growth of construction work this number was increased from time to time until it reached a maximum of 44 in August, including 12 engineering inspectors. There were also 6 masonry inspectors. On the approach of winter the force was reduced to 38 and 1 masonry inspector.

The main office of the department has been continued in Saxonville. It has been fitted up, and affords ample and convenient quarters for the general office, drafting rooms and cement-testing laboratory. The engineers of the second division also have their office in this building. Branch offices for the use of the first and third divisions, respectively, were rented in Framingham Centre and Wayland, and have been maintained since June 1. A branch office in Weston has been continued throughout the year for the use of the engineers of the fourth division. This office was moved on December 1 from unsuitable rented quarters to a house on Ash Street, which had been acquired by the Board through its purchase of land for the Weston Reservoir.

The day-labor force, consisting of a foreman and from 5 to 15 laborers, has been employed at different times during the year on a variety of preliminary work, such as the digging of test pits, making borings and rod soundings, and clearing timber and burning brush at the site of the Weston Reservoir.

General Statement.

From the beginning of the year the surveys and other preliminary work necessary for the final location and design of the aqueduct and its appurtenances were prosecuted vigorously. This work was so far advanced early in the spring that proposals were received on April 30 for the construction of the portions of the aqueduct which would require the longest time for their completion, and land upon which to build these sections of the aqueduct was taken May 17.

The preparatory work for other portions of the aqueduct was continued, and on August 27 proposals were received for the construction of the remainder of the masonry aqueduct. On November 21 proposals were received for the construction of the Weston Reservoir and the open channel above it.

The work now under contract comprises 9.14 miles of masonry aqueduct in open trench, 2.30 miles of aqueduct in five tunnels and 1.02 miles of open channel and reservoir, — a total of 12.46 miles, equal to 93 per cent. of the entire length of the work covered by this department. The total amount of these contracts is $1,815,898.40.

The portions of the aqueduct not yet let include the pipes leading from the Sudbury Dam to the upper end of the aqueduct, together with the head-house and other structures, and two steel siphon pipes, one across the valley of the Sudbury River north of Saxonville and the other across a depression known as Happy Hollow, about a mile east of the Sudbury River.

A contract has already been made for furnishing the pipes which are to lead from the Sudbury Dam to the head-house. All contracts for the aqueduct and reservoir provide that the work shall be completed on or before August 1, 1903.

Description of Works.

The course of the new aqueduct, starting at the Sudbury Dam and running easterly through the towns of Southborough, Framingham, Wayland and Weston, is shown on an accompanying map.

The aqueduct is designed so as to have in all parts a capacity for conveying 300,000,000 gallons of water per day; but, owing to the conformation of the country through which it passes, it varies in size and method of construction in different parts.

From the Sudbury Dam to the New York, New Haven & Hartford Railroad, near the Nobscot station, it was feasible to obtain a fall in the masonry aqueduct of 4 feet in 5,000, and for the remainder of the distance, down to the reservoir, a fall of only 1 foot in 5,000.

For the safe operation of the aqueduct it is necessary to have an equalizing reservoir near its lower end. A site suitable for such a reservoir was found in a valley rather more than a mile above the terminal chamber. The reservoir and an open channel leading to it have a total length of about a mile, and for this distance the masonry aqueduct will be omitted, the water flowing from the aqueduct into the upper end of the open channel, and, after passing through the open channel and reservoir, entering the lower section of the aqueduct.

The following table gives the length of the different portions of the aqueduct, beginning at the Sudbury Dam: —

	Feet.	Miles.
ıe,	479	.09
.	195	.04
.	704	.13
.	2,826	.53
.	3,015	.57
.	4,075	.77
.	2,160	.41
.	5,170	.98
rd		
.	130	.03
, .	9,690	1.83
.	3,603	.68
ı, .	3,465	.66
, .	1,123	.21
, .	16,470	3.12
.	5,686	1.08
er,	1,100	.21
.	1,366	.26
.	4,000	.76
, .	1,513	.29
.	600	.11
er,	3,612	.68
.	70,982	13.44

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	Elevation.
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. . .	208.723
. . .	206.319
. . .	205.626
. . .	204.739
. . .	200.087
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. . .	200.067

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PORTION OF WORK.	Feet.	Miles.
Three 5-foot cast-iron pipes from Sudbury Dam to head-house,	479	.09
Head-house and 10-foot aqueduct in open trench, . . .	195	.04
10-foot aqueduct in earth tunnel, ...	704	.13
10-foot aqueduct in open trench, ...	2,826	.53
10-foot aqueduct in rock tunnel, ...	3,015	.57
10-foot aqueduct in open trench, ...	4,075	.77
10-foot aqueduct in rock tunnel, ...	2,160	.41
10 foot aqueduct in open trench, ...	5,170	.98
Special section under New York, New Haven & Hartford Railroad, ...	130	.03
13-foot 2-inch aqueduct in open trench and siphon chamber, .	9,690	1.83
One 7½-foot riveted steel siphon pipe across Sudbury River, .	3,603	.68
13-foot 2-inch aqueduct in open trench and siphon chambers, .	3,465	.66
One 7½-foot riveted steel siphon pipe across Happy Hollow, .	1,123	.21
Siphon chamber and 13-foot 2-inch aqueduct in open trench, .	16,470	3.12
13-foot 2-inch aqueduct in earth and rock tunnel, . . .	5,686	1.08
13-foot 2-inch aqueduct in open trench and channel chamber,	1,100	.21
Open channel, ...	1,366	.26
Weston Reservoir, ...	4,000	.76
Screen chamber and 13-foot 2-inch aqueduct in open trench, .	1,513	.29
13-foot 2-inch aqueduct in rock tunnel, ...	600	.11
13-foot 2-inch aqueduct in open trench and terminal chamber,	3,612	.68
Total length of line, ...	70,982	13.44

The elevations in feet above Boston city base of the top of the inside of the aqueduct at its beginning and end and at intermediate points where there are changes in grade are as follows: —

LOCATION.	Elevation.
Head-house, ...	225.130
End of 10-foot aqueduct west of special section under New York, New Haven & Hartford Railroad, ...	210.660
Beginning of 13-foot 2-inch aqueduct east of special section under New York, New Haven & Hartford Railroad, ...	210.660
Siphon chamber No. 1, ...	208.723
Siphon chamber No. 2, ...	206.319
Siphon chamber No. 3, ...	205.626
Siphon chamber No. 4, ...	204.739
Channel chamber, ...	200.087
Screen chamber, ...	200.067
Terminal chamber, end of masonry aqueduct, ...	200.067

The top of the aqueduct at the head-house is 34.87 feet below high water in the Sudbury Reservoir. High water in the Weston

Reservoir is at elevation 200, substantially at the level of the top of the aqueduct, 66 feet higher than Chestnut Hill Reservoir and 37 feet higher than Spot Pond. From the terminal chamber the water will flow by gravity through large pipes to the low-service district and to Spot Pond.

Pipes from Sudbury Dam to Head-house.

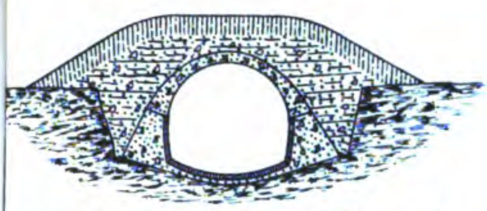
When the Sudbury Dam was constructed, 3 48-inch pipes were laid from the gate-house to a circular basin below the dam. These pipes are to be extended and utilized for supplying water to the new aqueduct. The extensions are to be made with 5-foot cast-iron pipes, two of which will have branches leading from them to discharge water from the Sudbury Reservoir into Framingham Reservoir No. 3. Two 60-inch Venturi meters will be placed on two of the lines leading to the head-house, for measuring the flow of the aqueduct. The head-house will be provided with screens and gaging appliances, and with an overflow so designed that the aqueduct cannot be overcharged through accident or negligence in regulating the flow from the gate-house at the dam.

Masonry Aqueduct and Tunnels.

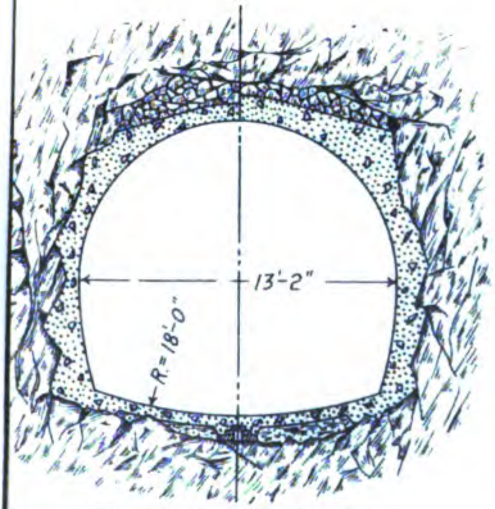
The aqueduct, both in open trench and in tunnel, will be of the same shape and type of construction as the Wachusett Aqueduct, described in the second annual report of the Metropolitan Water Board, for the year 1896, except that Portland cement concrete will be substituted for brickwork in the lining of the tunnels. An accompanying plan shows typical sections of the aqueduct. Where the aqueduct is built in open trench or on embankments, the bottom and side walls are constructed of natural cement concrete, lined with one course of brick masonry, and the arch of Portland cement concrete.

In the Wachusett Aqueduct it was found that by the contraction of the concrete, through temperature changes or otherwise, the sections of arch built at different times would separate where the new work joined the old, making a minute transverse crack. As the same result is expected in the Weston Aqueduct, a new device, called a water-stop, has been adopted, to reduce the possible leakage through such cracks.

In building the concrete, a straight groove is left in both the old



Aqueduct in Earth Trench



Tunnel in Rock
Concrete Lining
Grade 1 in 5000

WESTON AQUEDUCT

TYPICAL CROSS SECTIONS

DECEMBER, 1901.

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and new work, in the position shown upon the sections, forming a slot which extends from the top of the side walls to a point nearly at the level of the top of the inside of the aqueduct. In each of these slots is placed a strip of sheet lead extending from the top to the bottom, and bent in such a way that the lead will act as an expansion joint, and not be torn apart if a shrinkage crack is produced. The space around the lead is carefully filled with Portland cement mortar, but before filling with the mortar a piece of sheet iron is inserted in the fold of the lead, on a line with the junction of the sections of arch, so that if a shrinkage crack occurs it will extend through the mortar filling.

The arch centres, as in previous similar construction, have been covered with galvanized iron, to secure a smooth interior surface, and lubricated each time before laying the concrete, to prevent the concrete from adhering to the centres. Oil has been used as a lubricant, also soft soap, which has the advantage over oil of being easily washed off before applying a plastering, which is applied to all parts of the arch of the aqueduct in open trench. This plastering is of a thickness and finish equal to a plasterer's finished coat, and is composed of neat Portland cement, thoroughly trowelled in, and before the final set smoothed with a wet soft bristle brush, applied lengthwise of the aqueduct.

Siphons and Siphon Chambers.

At the valley of the Sudbury River the ground falls about 75 feet below the grade of the aqueduct, and at Happy Hollow about 50 feet below this grade. It is the design to lay ultimately across these valleys three 7½-foot riveted steel pipes, but only one is to be laid at the present time.

Where the pipe crosses the Sudbury River it will be given the form of an arch, between abutments 80 feet apart, so that it will support itself. Blow-off pipes will be provided for draining the siphons. Two will be placed on each pipe at the river, where large quantities of water can be discharged, and one at the bottom of the depression at Happy Hollow. One pipe will convey more than half as much water as the three, because when the aqueduct is running to only half its capacity it will be about half full at the down-stream end of the lower pipe and can be filled full at the upper end, giving more than the normal fall through the pipes.

The siphon chambers, which make the junction between the aqueduct and the siphon pipes, have been designed so that there will be the least possible disturbance of the flow in passing from one to the other. Some very large castings of special shape are to be built into masonry, to make the junction with the steel pipes. Grooves for gates are provided, so that when there is more than one pipe, any one can be shut off for examination and repairs.

Weston Reservoir and Open Channel.

The necessity for an equalizing reservoir arises from the fact that the pipes of the distributing system will convey more water in the daytime, when there is the larger use of water in the Metropolitan District, than at night, when less water is used, and consequently some of the water has to flow the much greater distance to Spot Pond. The site obtained for this reservoir is a satisfactory one, as there is a natural valley which can readily be dammed by an embankment of earth, with a concrete core wall founded upon solid rock. At the site of the dam there is a low, rocky ridge running most of the way across the valley, which by its presence makes the dam less costly than it otherwise would be.

The maximum depth of water at the dam is about 28 feet. The natural reservoir which would be formed by the dam without excavating above it would not be large enough to meet the requirements, and the reservoir is to be made much larger by excavating flat land which is nearly at the level of high water in the reservoir. All soil and organic matter are to be removed from the deeper portions of the reservoir, and where the depth of water obtained by the removal of the soil is less than 11 feet, the earth is to be excavated so as to obtain this depth.

The shores of the reservoir will be protected by riprap, or coarse gravel beaches, as conditions may require.

The open channel is practically an extension of the reservoir at its upper end, and the water will stand in it at the same level as in the reservoir. It will have a bottom width of 10 feet, with gravel sides sloping at the rate of 3 horizontal to 1 vertical. Above a berm 1 foot above the water the sides will be covered with loam and grassed. A stone arch bridge is to carry Ash Street over the open channel at the extreme upper end of the reservoir.

The open channel has a length of 1,366 feet and the reservoir a length of 4,000 feet, making a total length of 5,366 feet where the masonry aqueduct is omitted. The reservoir and open channel together have an area of water surface of 66.6 acres, which is a little more than half the area of Chestnut Hill Reservoir, and contain about 20,000,000 gallons per foot of depth. Where the masonry aqueduct terminates at the head of the open channel, a structure known as the channel chamber is to be built, which will contain grooves in which stop-planks may be placed if it is desired to empty the aqueduct without lowering the reservoir. Where the water flows from the reservoir into the lower section of the aqueduct a screen-chamber is to be built. In order to protect the waters of the reservoir and open channel from pollution, a system of drainage has been devised which will prevent the entrance of any water from local sources.

Especial attention has been given to the design of the outlines of the reservoir and to the disposition of waste material, so as to produce satisfactory landscape effects. These matters have been carefully studied by Olmsted Brothers, Landscape Architects, and they have given advice and furnished plans for the work.

Culverts and Crossings.

Thirty-nine culverts are required to provide for streams crossing the aqueduct, and additional culverts are provided through roads and private crossings where necessary.

The aqueduct, where not in tunnel, crosses 15 public highways, 4 of which are to be restored to their original grade, and the remaining 11 will be raised to pass over the aqueduct. In addition to the highways, there are private crossings provided over the aqueduct at 49 places.

CONTRACTS, WESTON AQUEDUCT.

Sections 2, 3, 6 and 12. — Masonry Aqueduct and Tunnels.

Contractor, Shanahan, Casparis & Co.; date of contracts, May 9, 1901; amount of contracts, $582,727.50; length of aqueduct, 24,975 feet, including 5,879 linear feet of tunnels. The aqueduct, on sections 2 and 3, has a width of 10 feet, and on sections 6 and 12 a width of 13 feet 2 inches.

The contractors were early on the ground, but some difficulty was experienced in securing labor and more or less delay was suffered in the erection of camps and the delivery of tools and materials, and the work of organization progressed slowly.

The headquarters and main camps for the accommodation of men and supplies are located principally on private land, in a secluded spot on the high ground over tunnel No. 2, about 2¼ miles from Framingham village and ⅓ mile from the nearest dwelling. Other camps are located about 1 mile north of Saxonville and 1½ miles southeasterly from Wayland.

The contractors have devoted almost their entire efforts to the construction of aqueduct in open trench, and the tunnel work, pending the erection of the power plant, was deferred until the close of the mild weather season. Progress in the open trench work on sections 2 and 3 has been generally satisfactory, slightly more than the work required having been completed this year.

The contractors were dilatory in perfecting their organization for Section 6, and excavation was not begun until June 10. The masonry construction was started August 22, and the amount of completed work at the close of the season was one-third less than the contract requirements, although the rate of progress for the actual time employed was satisfactory.

Progress on Section 12 was far from satisfactory until late in the season, organization and equipment suffering much delay. Masonry work was begun July 24, but little progress was made until the latter part of September; from that time until the close of the season a much better rate was maintained. The value of the work done on this section on November 15 was 23 per cent. of the amount of the contract, while the contract requirement was 30 per cent.

For about 700 feet on Section 3 and 300 feet on Section 6 the aqueduct crosses a swamp formation of moderate depth below the base of the aqueduct. The peat or mud deposit has been entirely removed down to compact earth, and filling for foundation has been prepared of selected material deposited in 3-inch layers, watered and rolled with heavy grooved rollers. With these exceptions the aqueduct under these contracts is being constructed partly or wholly in excavation. Considerable water was encountered in the open trench excavation between tunnels Nos. 2 and 3 and at the easterly end of Section 12. A small wooden box drain at the bottom of the excavation has usually sufficed to keep the water below the concrete during construction, although in a few instances, where a greater quantity of water was encountered, a light platform of fluted boards was laid in connection with the central drain.

The excavations have furnished considerable sand and gravel for use in the masonry on sections 2, 3 and 12, but the contractor has been obliged to obtain much of the sand for sections 2 and 3 and all of the sand used on Section 6 from private lands. It has also been necessary to operate stone crushers, with elevators, screens, bins, etc., on each of the sections included in these contracts, to furnish additional stone for concrete work.

For tunnel work, a central power plant, to furnish compressed air for operating the drills, pumps and other machinery in connection with tunnels Nos. 2 and 3, has been erected near Baiting Brook, a point nearly midway between the most distant portals of those tunnels. The compressed air is conveyed to the working points through wrought-iron pipes laid on the surface of the ground; the main air pipe, consisting of 4,200 feet of 5-inch and 5,100 feet of 4-inch pipe, is now laid and in operation.

The contractors placed their order for the machinery needed for this plant almost immediately after the execution of their contracts; but even this promptness, together with a guarantee from the manufacturer that one compressor would be running in 70 days and the whole plant completed within 100 days, did not avail in avoiding a long delay in the delivery; and it was not until December 2 that the first compressor was put in operation, and it was December 28 before all the machinery was in readiness to use. The main installation consists of two cross-compound air compressors of 150 horse-power each, and two horizontal tubular high-pressure boilers of 300 horse-power each.

Tunnel No. 1 is in a compact clayey material, and at present the lining of brick masonry is carried along with the excavation. Tunnels Nos. 2 and 3 are expected to be wholly through ledge, and the lining, which in these cases will be concrete masonry, will be deferred until the excavation is completed, or at least well advanced.

The following tabulation shows the progress made in these tunnels at the end of the year: —

Progress in Tunnels Nos. 1, 2 and 3, December 31, 1901.

TUNNEL.	Length (Feet).	Began Work.	EXCAVATION.		Total.
			East Portal (Linear Feet).	West Portal (Linear Feet).	
No. 1, . . .	704	November20, 1901,	23	-	23
No. 2, . . .	3,015	December 2, 1901,	82	-	82
No. 3, . . .	2,160	December 2, 1901,	-	83	83

The maximum force employed on these sections was 585 men and 83 horses, for the week ending August 31.

Section 4. — Masonry Aqueduct.

Contractor, Patrick McGovern; date of contract, May 6, 1901; amount of contract, $64,888.50; length of aqueduct, 4,155 feet; width, 10 feet.

Work was begun early under this contract, and most excellent progress has been made during the season. The value of the work completed November 15 was 72 per cent. of the amount of the contract, while the contract requirement was 30 per cent. The aqueduct is entirely in open trench. For about 1,600 feet east of Edgell Street the excavation was in light sandy material, affording excellent opportunity for rapid progress; west of Edgell Street the excavation has been more difficult, considerable ledge having been encountered. At several points gravel was developed, affording material for concrete masonry, but a stone crusher to furnish additional material was found necessary early in the season. East of Edgell Street the foundations were below the level of ground water for some distance, and a light platform of boards with central drain was employed to keep the concrete dry until hardened.

The maximum force employed on this section was 120 men and 18 horses, for the week ending August 10.

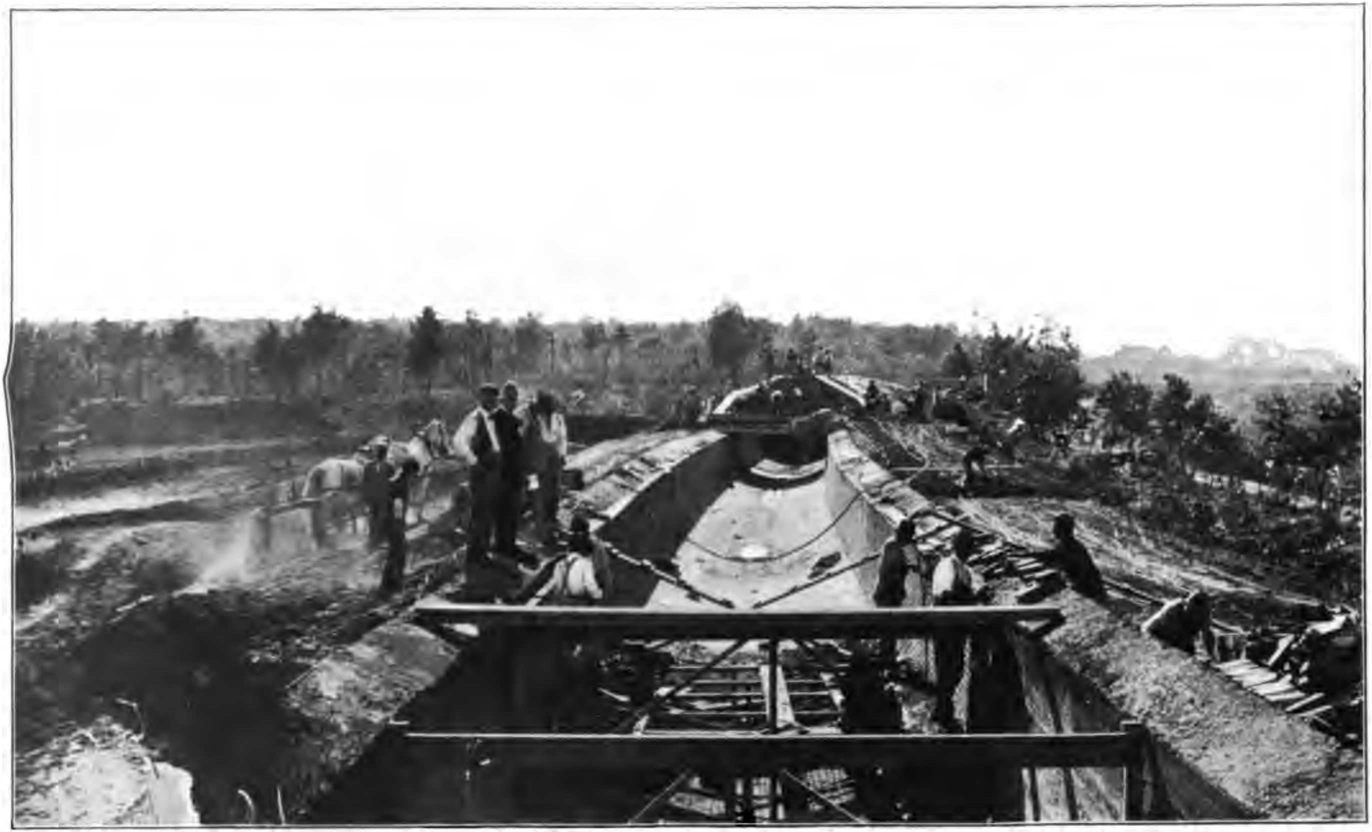
Section 5. — Masonry Aqueduct.

Contractor, Bruno, Salomone & Petitti; date of contract, May 8, 1901; amount of contract, $137,526.50; length of aqueduct, 5,295 feet, including crossing under the tracks of the New York, New Haven & Hartford Railroad at Nobscot station; width of aqueduct, 13 feet 2 inches.

These contractors commenced operations very promptly, and prosecuted their work vigorously during the working season.

The aqueduct is principally in open trench, but at one place, for a length of 1,400 feet, the original ground surface is from 1 to 6 feet below the bottom of the masonry. For that space the foundation was prepared by removing the soil and building an embankment in 3-inch layers, using water and heavy grooved rollers to consolidate the material, and after completion the embankment was flooded twice before laying the masonry. The material used for filling was a very fine sand, with coarse gravel at the sides of the embankment.

The masonry construction could not well be begun until a section of this embankment had been completed, and consequently it was not started until July 29; but excellent progress was maintained



WESTON AQUEDUCT -- SECTION ON EMBANKMENT, DURING CONSTRUCTION.

UNIV. OF MICH.

until it was necessary to stop on account of freezing weather. It was deemed desirable that this embankment, once begun, should be made and the aqueduct completed before freezing weather, and by concentrating their forces the contractors were successful in accomplishing this result.

The value of the work completed November 15 was 36 per cent. of the amount of the contract, while the contract requirement was 30 per cent.

A stone-crushing plant was in nearly constant operation, to furnish the balance of the stone not obtainable by screening the gravel excavated from the trench.

The maximum force employed on this section was 132 men and 41 horses, for the week ending September 28.

Section 13. — Masonry Aqueduct and Tunnel.

Contractor, Michael H. Keefe; date of contract, May 20, 1901; amount of contract, $346,290; length of aqueduct, 7,300 feet, of which 5,686 feet are tunnel; width of aqueduct, 13 feet 2 inches. This contract was assigned to the Columbus Construction Company October 12.

Proposals for the construction of this section of the aqueduct were first received April 30. The lowest bid amounted to $293,083.25 and the next bid to $395,390. The contract was awarded to the lowest bidder, but he claimed that he had made a mistake in his calculations, and declined to sign the contract. The Board thereupon decided to reject all bids and to receive further proposals on May 14. The lowest of these proposals, amounting to $346,290, was accepted.

The contractor started upon the work very promptly, and, notwithstanding the scarcity of labor and the delays arising from slow delivery of machinery and supplies, the excavation of the west portal had progressed sufficiently to begin a tunnel heading on June 24. The boilers and engine for the air compressor were received the latter part of June, but were not ready for operation until August 16. The excavation of the open cut at the east portal of the tunnel progressed slowly, and tunnelling was not commenced at that end until August 26.

During the summer and early autumn the progress upon the tunnel, which needed to be large to meet the contract requirements, was quite unsatisfactory; and it soon became apparent that more plant and resources than the contractor appeared to have at his disposal would be necessary in order to complete the contract within the stipulated time. An arrangement was therefore perfected for obtaining additional capital by the organization of a company to carry on the work; and by the consent of all parties the contract was assigned on October 12 to the Columbus Construction Company, of which S. Casparis is president, Joseph A. Flynn secretary and treasurer, and Mr. Keefe one of the stockholders.

Immediate steps were taken by the Columbus Construction Company to increase the working facilities. Additional and improved boarding houses for the laborers, as well as engine houses, stables, shops and cement sheds, were built. A second compressor engine and another boiler were ordered, and were put in operation November 2. An engine and dynamo were also installed to furnish electricity for lighting and motive power in tunnel. The working force was increased as rapidly as boarding accommodations could be provided, and throughout the month of December a full force of about 140 men, divided into day and night shifts, was employed.

It necessarily required some weeks to accomplish this preliminary work, and until it was completed the greatest possible rate of progress in the tunnel excavation could not be expected; but afterwards there was a continued gain in the rate of progress, although up to the end of the year the desired rate had not been fully attained, largely on account of the unfavorable conditions of the ground at the west end of the tunnel. At this end of the tunnel, for the whole 530 feet excavated from the portal to the point reached at the end of the year, the lower part of the tunnel has been in rock and the upper part in a compact clayey material, which is so hard as to require drilling and blasting, but wet enough to render it unstable, and to require continuous and systematic timbering for its support. In this material the progress has necessarily been slower than in the solid rock, such as is encountered at the east end of the tunnel. There the formation is a massive, coarse-grained granite, which is hard to drill, but blasts well and does not require support.

The total length of the tunnel is 5,686 feet, and at the end of the year the total amount excavated was 1,001 feet, consisting of 530 feet at the west end and 471 feet at the east end, which was 559 feet less than the requirements at this time.

The power station is located at the west portal of the tunnel, and contains two Ingersoll-Sergeant straight-line 18-inch by 18¼-inch by 24-inch air compressors; two Westinghouse standard engines of 60 horse-power and 20 horse-power, for driving electric generators; and one Thomson-Houston 500-volt, 70-kilowatt direct-current generator, to furnish electricity for lighting and for operating 4 ½-ton electric locomotives in each end of the tunnel. Additional machinery in use outside of the central station includes 2 double-cylinder double-drum hoisting engines, to operate the inclines by which material is removed from the tunnel; 2 duplex pumps and 2 pulsometers, to drain water from the tunnel; 11 machine drills, and 1 6-ton saddle tank locomotive for hauling material from the east portal to the waste dump, about 2,000 feet distant. As soon as the General Electric Company can deliver them, it is proposed to substitute two 4½-ton electric locomotives for the horses now used for hauling cars underground.

None of the concrete masonry, which it is anticipated will be used almost exclusively for lining in this tunnel, had been built before the end of the year; but preparations are under way for an early start on this lining, as, in order to finish the whole work on time, it will be necessary to have the masonry and excavation proceed simultaneously. The brick arched concrete culvert under Wellesley Street has been completed, except the masonry head walls.

Of the excavation from open trench beyond the ends of the tunnel, about one-quarter of the total amount has been made. At the east end of the section, where a deep trench is required, the material was removed with a steam shovel.

The maximum force employed on this section was 147 men and 5 horses, for the week ending December 21.

Sections 8 and 10, 11 and 15.—Masonry Aqueduct and Tunnel.

Contractors, Winston & Co.; date of contracts, August 28, 1901; amount of contracts, $466,419; length of aqueduct, 18,715 feet, inclusive of 3 siphon chambers on sections 8 and 10, and the screen and terminal chambers and 600 feet of tunnel on Section 15; width of aqueduct, 13 feet 2 inches.

These contracts were awarded so late in the season that it was not expected that very much work would be done, except on Section 15, where the excavation of the tunnel and some rock cuts could be continued during the winter.

As all of these sections were let to one contractor, it was thought that he might perfect his organization for masonry construction without building masonry on more than one section; and the contractor chose the easterly portion of Section 8 as a favorable place to begin the building of masonry. He lost no time in commencing operations, and pushed his work with most commendable energy.

On Section 8 excavation was commenced September 9, the first masonry laid October 10, and 500 linear feet of aqueduct completed before the close of the season. This, together with 800 feet of trench excavation on this section and other preliminary work done, may be said to represent about double the contract requirements for sections 8 and 10, which are included in one contract.

An abundance of excellent sand and gravel was found in the excavations on Section 8, and a rotary power screen, with conveyor, bins, etc., has been operated to separate the sand and gravel, resulting in much economy over hand methods.

On sections 10 and 11 nothing has been done further than clearing the strip taken for the aqueduct, removing the wood and burning the brush.

On Section 15 the necessity of grading roads to get access to the work, before camps could be built, and the further need of obtaining a water supply before much grading could be done, tended to delay the commencement of actual work until September 28. Since that date the clearing, grubbing and excavating have progressed steadily, although rather slowly; and at the end of the year about half the amount of work required by the contract had been completed. The actual progress, however, should be regarded as greater than indicated by the above statement, as a large part of the preliminary work of organization, building camps and installation of machinery had been accomplished.

To furnish power for running drills in the tunnel and open trench and for hoisting and pumping, a plant consisting of 3 70-horse-power boilers and a Rand Imperial air compressor of 120 horse-power has been provided, and was put in operation November 25. Other machinery on the ground, but not yet all in use, includes travelling derrick and hoisting engine complete, 7 machine drills, 1 No. 5 Gates crusher with engine and elevator, pumps, cars, rails, etc.

The maximum force employed on these sections was 118 men and 32 horses, for the week ending October 26.

Section 14. — Open Channel. — Sections 1 and 2, Weston Reservoir.

Contractor, Nawn & Brock; date of contracts, November 26, 1901; amount of contracts, $206,370; length of three sections, 5,050 feet, including about 1,400 feet of open channel, 66.6 acres of reservoir and channel, and an earth dam 900 feet long, with concrete core wall.

These contracts were let in the autumn, before the ground was covered with snow, so that the contractor might arrange for the erection of buildings, the delivery of machinery and the organization of forces during the winter, and make an early and vigorous beginning as soon as the frost leaves the ground. No work has been done on the ground under these contracts.

In order to provide a main drainage channel, so that the reservoir would be well drained for the commencement of work in the spring, and to get it in condition at the time of the letting so that contractors might have access to all parts of the reservoir and see the nature of the materials, a considerable amount of work was done by a day-labor force in the summer and autumn, in digging the main channel and lateral ditches, in excavating test pits, in laying bare a portion of the rock at the site of the dam and in cutting the brush from the site of the reservoir.

PROGRESS OF WORK AND MATERIALS USED.

During the season the total length of aqueduct built in open trench equalled 11,222 feet, or 23 per cent. of the total length. The following statement gives the length of aqueduct built and to be built in open trench on each section: —

SECTION.	Built.	To be Built.	SECTION.	Built.	To be Built.
Section 2, . . .	2,368	2,368	Section 10, . .	–	2,925
Section 3, . . .	1,417	1,923	Section 11, . .	–	6,600
Section 4, . . .	3,271	884	Section 12, . .	1,264	5,236
Section 5, . . .	1,567	3,728	Section 13, . .	–	1,614
Section 6, . . .	841	3,679	Section 15, . .	–	5,125
Section 8, . . .	494	2,971			

The following materials have been used during the year: —

Natural cement (barrels), ...	26,658
Portland cement (barrels), ...	13,810
Bricks, ...	1,601,000

ENGINEERING.

The time of the engineering force has been devoted wholly to the completion of the preliminary surveys, preparation of plans and other matters pertaining to the several contracts which have been awarded during the year, and later to the direction and supervision of the work under construction.

Extraordinary care was taken in the surveys and studies for the location of the aqueduct and other structures, to insure the best and most economical adjustment of the same to existing natural conditions; and during the early spring considerable attention was given to a final revision of the alignment of the aqueduct and open channel and margins of the Weston Reservoir. To aid in these studies, further information was gained relative to the character of materials to be moved, by digging 74 test pits, amounting to a total of 380 linear feet, and by 10 wash drill borings and 664 rod soundings, aggregating, respectively, 144 and 6,015 linear feet.

Considerable time and study have been given to the location of the steel siphon pipes to cross the Sudbury valley and Happy Hollow.

The nature and area of the watersheds and the position and sizes of the culverts to carry the drainage across the aqueduct were determined, and 43 topographic and 46 detail culvert plans have been furnished in this connection. The required changes in grade for the various highway crossings in Framingham and Wayland were carefully studied, and plans for the modification of 13 roads have been prepared.

Plans for the highway crossings in Framingham have been accepted by the selectmen; those for Wayland have not yet been acted upon.

The work in connection with the matter of lands required for the aqueduct and reservoir has taken much time. Surveys were made of all estates crossed by the aqueduct, as well as many adjoining tracts, and land-taking plans have been drawn to cover the whole work. These consist of 20 large sheets, showing dimensions, areas, etc., of the 153 parcels of land taken for aqueduct and reservoir purposes; in addition to these, 3 long roll plans, showing the land surveys and takings on a scale of 100 feet to 1 inch, have been prepared for office records.

Estimates of quantities and cost were furnished as required, to serve as a basis in letting contracts for the 14 sections for which proposals were received.

Cement testing was an important branch of the work in this department, and received careful attention. A room was suitably equipped for this work, and the testing begun on June 3, when the first carload of cement was received. One cement tester was employed until June 27, when it was necessary to give him an assistant. A third man has been employed collecting samples and noting deliveries of cement and bricks. All the cement received thus far has been packed in jute or cotton bags, ranging from two to four bags to the barrel, according to the brand of cement. A system of marking, consisting of attaching to each bag a tag giving the car number, has been followed. This serves to identify the cement to the inspector on the work, who is furnished with a list of accepted carloads.

During the year 301 carloads of cement, containing 45,365 barrels, were received and tested, and 14,000 briquettes were made for the purposes of the tests required. Thus far only four kinds of cement have been used in this masonry, viz., Hoffman, Union, Atlas and Giant. A summary of the cement tests is given in Appendix No. 2.

The bricks used in the aqueduct have come principally from the Granite State Company of Epping, N. H., but a few were from the Star Brick Company of the same place, and another small lot from the Cambridge yards of the New England Brick Company. Something over 2,000,000 bricks have been received during the year.

DISTRIBUTION DEPARTMENT.

DEXTER BRACKETT, *Department Engineer.*

The work of this department comprises the construction, maintenance and operation of the pipes, distributing reservoirs, pumping stations and all other works in the Metropolitan Water District, with the exception of Chestnut Hill Reservoir and the grounds about it, and the Sudbury and Cochituate aqueducts.

During the past year the work of the department has been under the direct charge of the following assistants: —

William E. Foss, division engineer, has had charge of the engineering work connected with the construction of the Bear Hill Reservoir, in Stoneham, and the laying of pipe lines for supplying that town with water; also of studies and investigations relating to the injury of the pipes by electrolysis, and of surveys and investigations for pipe lines leading from the terminus of the new Weston Aqueduct.

John L. Howard, division engineer, has been in charge of the engineering work connected with construction at the Chestnut Hill and Spot Pond pumping stations; also of making surveys, plans and estimates for pipe lines leading from the terminus of the new Weston Aqueduct into the Metropolitan Water District.

Caleb M. Saville, division engineer, has had charge of the engineering work connected with the Forbes Hill Reservoir and tower in Quincy, and the tunnel for pipes under the channel of the Mystic River between Charlestown and Chelsea.

Alfred O. Doane, division engineer, has had charge of the engineering work connected with the maintenance and operation of the several pumping stations and pipe lines, the installation of gages for recording the elevation of the water in the reservoirs and the pressure in the pipes; also of the records of amounts of water pumped and consumed.

John W. Lynch, engineer of pumping stations, has had direct charge of the high and low service pumping stations at Chestnut Hill, as well as the general supervision of the mechanical work at the other pumping stations.

George E. Wilde, assistant superintendent, has continued in charge of the maintenance and operation of pipe lines, reservoirs and other works in the Distribution Department, with the exception of the pumping stations; and has also had charge of the minor works of construction which have been done by day-labor forces.

The engineering force, including inspectors, numbered 34 at the beginning of the year, but has gradually diminished, and at the close of the year numbered 23.

The construction work of the year has included the completion of the buildings and machinery at the new pumping stations at Chestnut Hill and Spot Pond. The reservoir on Forbes Hill has been finished and placed in service, and the masonry tower around the standpipe near the reservoir is nearly completed. Pipes for furnishing a supply of water from the Metropolitan Works to the town of Stoneham have been laid and are now in use. The Bear Hill

Reservoir, which will be used for furnishing water to Stoneham under a greater pressure than at present, was nearly finished when work was suspended for the season.

PIPE LAYING.

The only important extension of the pipe system was made for the purpose of furnishing a supply of water to the town of Stoneham, which entered the Metropolitan Water District on May 23, 1901. A 24-inch line, 5,831 feet in length, was laid from the Spot Pond pumping station around the northeasterly end of Spot Pond to the junction of Main and South streets; from this point a 20-inch line, 1,619 feet in length, extends through the Middlesex Fells Reservation to the Bear Hill Reservoir; and another 20-inch line, 4,766 feet in length, through Main Street to Stoneham Square, where it connects with the main pipe of the town. A Venturi meter was set in the pipe line near the pumping station, for use in measuring the quantity of water used in Stoneham.

A contract for laying these pipes was made with the C. H. Eglee Company of Boston, on June 22, and the work was commenced June 25. The portion of the line between the pumping station and the town of Stoneham was completed and placed in service on October 21, but the pipes connecting with the Bear Hill Reservoir were not all laid until December 4.

In connection with this pipe laying a five-conductor lead-covered cable was laid between the pumping station at Spot Pond and the Bear Hill Reservoir, for use in connection with a gage for indicating and recording at the pumping station the elevation of the water at the reservoir, and also for telephone service.

The cost of this work, exclusive of engineering, to December 31, 1901, was $48,442.75.

BEAR HILL RESERVOIR.

This reservoir, which will contain 2,000,000 gallons of water with a full reservoir level 300 feet above Boston city base, is being constructed for the purpose of furnishing a greater pressure in the town of Stoneham than would be furnished by the Fells Reservoir, which is 29 feet lower. It is located in the Middlesex Fells Reservation, near the summit of Bear Hill, and is formed by building two dams across a depression in the rocky ridge forming the hill, and excavating all the earth and some of the rock from the enclosed area.

A contract for building the reservoir was made with the C. H. Eglee Company of Boston, on July 16. Work was begun on July 27, and at the close of the season the concrete masonry dams were nearly finished, the substructure of the gate-chamber completed, and most of the earth and rock removed from the interior of the basin. The reservoir has been filled with water to within 3½ feet of high-water mark, for the purpose of protecting the masonry.

The cost of the work, exclusive of engineering, to December 31, 1901, was $18,667.70.

Forbes Hill Reservoir and Masonry Tower.

A contract for building this reservoir was made with Beckwith & Quackenbush of Mohawk, N. Y., on July 7, 1900; and when work was suspended, at the close of the year 1900, the masonry gate-chamber of the reservoir was finished and the earth embankments were nearly ready for the concrete lining. During the winter the reservoir was kept full of water, in order to protect the embankments from freezing. In April, 1901, the water was drawn off, and the contractors resumed work on May 6. The work of placing the concrete lining was commenced June 10 and completed September 18. Water was pumped to the reservoir on September 23, and on September 27 it was filled to within 2 feet of high-water mark. The laying of the granolithic walks and the surfacing and seeding of the embankments were not finished until early in November.

The reservoir is in the form of a rectangle, 280 feet long by 100 feet wide at the bottom, and 339½ feet long and 159½ feet wide at the high-water line. The embankment is 15 feet wide at the top, with an inner slope of 1.75 horizontal to 1 vertical, and an outer slope of 2 horizontal to 1 vertical. The embankments are composed of clayey hardpan, excavated from the interior of the reservoir. This material was placed in 4-inch layers and thoroughly rolled with grooved rollers. The bottom and sides of the reservoir are covered with concrete to a point 2 feet above high-water mark. This concrete lining was put on in two layers, a lower layer of natural cement concrete and an upper layer of Portland cement concrete, separated by a plastering of Portland cement mortar about half an inch in thickness. The plastering also was placed in two layers, the bottom layer composed of 1 part of cement and 2 parts of sand, the upper layer of neat cement, which was rubbed to a hard, smooth surface, in order to make it as impervious as possible. The lower layer of concrete is 4 inches thick on the bottom of the reservoir and 6 inches thick on the slopes. The upper layer is 4 inches thick on the bottom and 5 inches thick on the slopes up to elevation 185, above which it gradually increases to a thickness of 2 feet at the top, which is at elevation 194. The upper layer of concrete on both bottom and slopes is laid in blocks, about 10 feet square, and given a smooth finish. A granolithic walk 6 feet wide extends around the reservoir on the top of the embankment, access to which is obtained by granite steps on either side of the gate-chamber.

The gate-chamber is constructed entirely below the level of the top of the embankment. It has walls of Portland cement concrete, and contains two chambers. One of these chambers is 11 feet by 3 feet, and contains screens, a 30-inch sluice valve and a 12-inch drain valve. The other chamber, from which water is excluded, is 11 feet by 9 feet 6 inches, and contains valves for controlling the flow of water to and from the reservoir. A wire fence 5 feet high and about 2,035 feet long has been built around the reservoir, on the line dividing the water works property from adjoining estates. When filled to high-water level, the elevation of the reservoir is 192 feet above Boston city base, the depth of water is 17 feet, area of water surface 1.23 acres, and the capacity is 5,120,000 gallons.

The cost of the reservoir, exclusive of engineering, to December 31, 1901, was $36,833.11.

On May 23 a contract was made with James E. McCoy of Boston for the construction of a masonry tower around the steel standpipe which was erected in 1900. The work was commenced on May 27, and it was expected that the tower would be entirely finished before the end of the year; but, on account of delay in receiving cut granite, the masonry is still unfinished, and practically nothing has been done on the iron stairway and roof. The circular wall of granite masonry surrounding the standpipe is now built to a point about 70 feet above the ground and about 7 feet below the top of the finished coping. When completed, the tower will be provided with an observation roof reached by a spiral staircase built between the steel tank and the masonry wall.

The cost of the work to December 31, 1901, exclusive of engineering, was $11,774.05.

LOW-SERVICE PUMPING STATION AT CHESTNUT HILL AND NORTHERN HIGH-SERVICE PUMPING STATION AT SPOT POND.

On January 1, 1901, the buildings at both of these stations were completed, with the exception of laying the slate floors in the engine rooms; and the engines were in operation, but had not been painted or officially tested and accepted.

At the Chestnut Hill Station, Norcross Brothers, the contractors, began the work of laying the slate floor on January 21 and completed the same on April 3. At the Spot Pond Station, McNeil Brothers began work on the floor on January 21 and finished on February 9.

At the low-service station at Chestnut Hill a steam winch, furnished by the American Ship Windlass Company of Providence, R. I., has been placed in the coal shed for use in handling coal cars. The winch has a small reversible engine with two 7-inch by 10-inch steam cylinders. At the Spot Pond pumping station a 15-kilowatt electric generator, directly connected to a 6-inch by 8-inch Alfree high-speed engine, and a new switchboard, have been installed, at a cost of $1,235.

The building and machinery at both of these stations are now completed, and the principal items of cost to December 31, 1901, exclusive of engineering, are as follows: —

Chestnut Hill Low-service Pumping Station.

Building, including foundations for engines and boilers, steel overflow tank, sluice valves, ash lift, heating piping and wiring for electric lighting,	$214,906 65
Engines,	153,556 47
Boilers and fuel economizer,	23,712 40
Electric lighting engine, generator and switchboard,	2,087 00
Travelling crane,	2,812 00
Piping and valves in connection with engines and boilers,	16,043 16
Miscellaneous,	5,894 57
Total,	$419,012 25

Spot Pond Pumping Station.

Building, including foundations for engines and boilers, sluice gates, heating piping and electric lighting,	$125,866 36
Engines,	100,787 88
Boilers and fuel economizer,	25,816 42

Electric lighting engine, generator and switchboard,	$1,235 00
Travelling crane,	2,862 00
Water and steam pipes, valves, etc.,	10,007 15
Miscellaneous,	1,083 43
Total,	$267,658 24

The official tests of the four new engines in the low-service and Spot Pond pumping stations were made April 30 and June 4, and the results of the tests, including a description of the pumping plants, may be found in Appendix No. 4.

MISCELLANEOUS.

A small masonry chamber has been built on the Cochituate Aqueduct, near the high-service pumping station, from which water can be taken through a 48-inch pipe to either the high or low service stations. The substructure of this building was built by the maintenance force. The chamber is 7 feet by 9 feet 6 inches and 13 feet deep, with foundations and walls of Portland cement concrete, and contains grooves for stop-planks or screens, and a sluice gate for controlling the flow of water. The superstructure was built by Norcross Brothers, at a cost of $1,552. It is 10 feet 4 inches square on the outside, with exterior walls of quarry-faced Milford granite, brownstone trimmings and a slated roof. The interior is lined with red pressed brick.

In order to increase the supply into the pump-wells at the high-service station at Chestnut Hill, a connection 36 inches in diameter has been made between the screen-chamber and the pump-well of engine No. 4. The castings and sluice valve for this work were purchased in 1900, but a favorable opportunity for setting the castings and valve did not occur until 1901. The work of cutting through and restoring the walls of the screen-chamber and pump-well and placing the castings and sluice gates was done by the maintenance force, and completed at the end of the year.

For the purpose of indicating and recording at the Chestnut Hill high-service pumping station the elevation of the water in the Waban Hill Reservoir, a Winslow electric gage has been installed, and a 5-conductor lead-covered cable, 7,650 feet in length, laid under ground between the pumping station and the reservoir. To provide facilities for emptying this reservoir, in case of repairs, without injury to private property, 489 feet of 8-inch Akron pipe were laid in Commonwealth Avenue, connecting with the surface drainage system in the avenue, and 150 feet of 8-inch iron drain pipe were lowered in Ward Street.

At Spot Pond the planting of trees and shrubs was completed early in the spring by the maintenance force, under the supervision of Olmsted Brothers, Landscape Architects.

The maintenance force has also laid near Spot Pond 200 feet of 8-inch Akron pipe, for the purpose of draining the cellar of the stable belonging to the Metropolitan Park Department; and 1,900 feet of 3-inch tile drain, for draining the land near the junction of Pond and South streets and in the vicinity of the southern gatehouse.

The boiler room of the Arlington pumping station has been enlarged by building an addition, 9 feet by 15 feet, on the north side of the building, making room for a reserve boiler which was purchased from the city of Chelsea. The boiler is 72 inches in diameter, 9 feet 7 inches long, and contains 350 2-inch tubes, 6 feet 1 inch long. The addition to the building was built and the boiler erected by the maintenance force.

ENGINEERING.

The engineering force has been engaged upon the preparation of plans and contracts, and the superintendence of the construction of the Bear Hill Reservoir and of the pipe lines for supplying the town of Stoneham, the superintendence of the construction of the Forbes Hill Reservoir and masonry tower, the tunnel between Charlestown and Chelsea, and work at the Chestnut Hill and Spot Pond pumping stations. Surveys and investigations have been made of several routes for pipe lines leading from the terminus of the Weston Aqueduct into the Metropolitan District, and detailed plans have been made of two of these routes leading to Chestnut Hill Reservoir and of one route leading to the present 48-inch pipes in the Brighton district. Surveys and plans have also been made of several routes for a pipe line between the present terminus of the 48-inch main near College Hill in Medford and Spot Pond. Estimates have been made of the pipes, special castings and valves required for these lines, and specifications and contracts prepared for furnishing the same. Considerable time was devoted to making the official duty trials of the Holly engines at the Chestnut Hill and Spot Pond stations, and to calculating the results. Investigations relating to the effect of electrolysis on the water pipes in the District have been continued, and a special report made upon the subject. Investigations and reports have also been made upon Spot Pond Brook, upon the value of the property taken at Spot Pond from the cities of Malden, Medford and Melrose, upon alleged damage to private property near Spot Pond by flooding during freshets, upon the use of hand-hose and lawn sprinklers in the Metropolitan District, upon the elevation at which water can be maintained in Mystic Lake, and upon the question of supplying water to the town of Braintree.

OFFICE FORCE.

ALFRED D. FLINN, *Principal Office Assistant*, JOHN N. FERGUSON, *Office Assistant*.

Mr. Flinn has continued in charge of the designing and drafting force. The average number in this force during the year was 10. The most important matters upon which the force has been engaged were the Weston Aqueduct and Reservoir, the Wachusett Dam and the masonry tower to enclose the Forbes Hill standpipe.

Studies for the Weston Aqueduct and Reservoir were in progress in 1900, and were continued during 1901. Designs for the greater part of the work were matured and contract plans and specifications were prepared for the letting of almost all of the aqueduct and the reservoir.

The designing for this aqueduct involved an unusual amount of detail work. On account of the different grades of the upper and the lower portions, the aqueduct is of different dimensions. Earth and rock tunnels and a depression of the aqueduct under the New York, New Haven & Hartford Railroad at the Nobscot station required special designs. There were also 42 culverts and about 14 other structures, the principal of which are the outlet chamber near the Sudbury Dam, the head chamber of the aqueduct, 4 siphon chambers, the channel chamber, the screen-chamber and the terminal chamber. Some studies relating to the superstructures for these chambers were made in the drafting office, and foundation plans and other information were prepared for the architects, Messrs. Shepley, Rutan & Coolidge.

The Weston Reservoir and open channel, with the dam and the system of drainage for diverting from the reservoir the water from adjacent lands, required much designing. As already stated, Olmsted Brothers advised with regard to the landscape treatment and the disposal of the material excavated, but much was done upon this work by the designing and drafting force.

A considerable part of the work of preparing the plans for the taking of land for the Weston Aqueduct and Reservoir was done in this office, and a large map was drawn to show the location of the aqueduct.

In connection with the Wachusett Dam, construction drawings were made for a portion of the pool and spillway below the dam, and for the castings and pipes to be built into the dam and the upper and lower gate-chambers. Construction drawings were also begun for these two chambers, and at various times additional study was devoted to the power plant which it is proposed to install in the lower gate-chamber and power house. Sketches and other information relating to the design of the superstructure of these buildings have been furnished to Messrs. Shepley, Rutan & Coolidge.

Contract drawings and specifications for the Forbes Hill tower were prepared on the basis of the sketch for the design furnished by Messrs. Shepley, Rutan & Coolidge in 1900.

The preparation of the card index of the drawings mentioned in the last report was continued by the typewriters from the Library Bureau, and completed by them in February; since then the necessary card writing has been done by the regular employés.

The removal of the offices of the Board and of the Engineering Department from 3 Mt. Vernon Street to 1 Ashburton Place, and the construction of a fire-proof vault in the new office required a general rearrangement of the drawings, which involved much work, in order to get them permanently and conveniently filed; but the results are satisfactory, as the drawings are now properly filed and indexed, and important drawings are safely protected against fire.

The following is a summarization of the matters upon which the department was employed: —

Weston Aqueduct: Preliminary studies and investigations; contract drawings for sections 2, 3, 4, 5, 6, 8, 10, 11, 12, 13, 14 and 15, including chambers, culverts and other structures; land plans; detail drawings of siphon and other chambers, culverts and other features; studies for superstructures of head, siphon, channel, screen and terminal chambers; studies for head works, Section 1;

contract drawings for special castings and pipes for Section 1 and the siphon chambers; studies and drawings for sections 7 and 9, including the crossing of the Sudbury River; and map of aqueduct location.

Weston Reservoir: Preliminary studies; landscape treatment; dam; drainage around reservoir; Ash Street relocation and bridge over open channel; and contract drawings and specifications.

Wachusett Dam: Construction drawings for pool and spillway; construction drawings for upper and lower gate-chambers (unfinished); special castings, pipes and valves; power plant; superstructure for power house; and automatic registering gate.

Wachusett Aqueduct: Record drawings of culverts, highway bridges and Assabet bridge.

Wachusett Reservoir: Miscellaneous plans for hearings.

Relocation of Central Massachusetts Railroad: Studies for highway bridges.

Clinton Sewerage: Record drawings.

Diversion of Water: Drawings for Nashua River Paper Company's suit.

Sudbury Dam: Bronze tablet for inside of gate-house.

Improvement of Lake Cochituate: Snake Brook and Pegan meadows.

Chestnut Hill Reservoir: Screen closet and washing apparatus for effluent gate-house No. 2.

Southern High-service Reservoir: Forbes Hill masonry tower.

Distribution Department, Pipe Lines: Record drawings and diagrams relating to electrolysis.

Distribution Department, Miscellaneous: Screens, stop-planks, lifters for screens and stop-planks, sluice gates and floor plates for gate-houses; tests of Holly pumping engines (low and northern high service); assembly drawings of Holly low-service pumping engines; coal car handling apparatus for low-service pumping station; re-arrangement of machinery in West Roxbury pumping station; and record drawings of pumping stations.

Miscellaneous: Diagrams of heights and conditions of reservoirs; drawings and tables for annual report of 1900; and indexing and filing drawings and calculation books.

In all, 195 finished drawings were made during the year, also many studies, sketches and computations.

Mr. Ferguson has continued in charge of the miscellaneous work of the office, such as receiving applications from those desiring employment, procuring supplies, making blue-prints and filing plans and records received from outside offices. He has furnished much assistance to the Conveyancing Department in the preparation of land plans, has made many investigations and computations, and has done much other work of so varied a character that it cannot be enumerated in a report. The average force in his department has numbered 8.

ACCIDENTS.

Seven fatal accidents have occurred during the year, 3 at the Wachusett Reservoir, 2 at the quarry which furnishes stone for the Wachusett Dam and 2 on the Weston Aqueduct.

All of those at the reservoir occurred in connection with the operation of trains; 2 on the railway used by Nawn & Brock and 1 on the railway used by Long & Little.

Of the 2 accidents which occurred at the quarry, the first occurred where a laborer slipped and fell a short distance, and one of the weights of the power drill with which he was working fell upon him, fracturing his skull; the second occurred when a laborer was loosening stone from one of the walls of the quarry with a bar, which fell upon him, causing almost instant death.

The first accident on the Weston Aqueduct occurred on Section 4, where an engineer of the stone crusher was fatally injured by falling into the fly-wheel when it was in motion; the second accident occurred on Section 12, where a mechanic who was erecting a bin for crushed stone was killed by the fall of one of the supports.

MAINTENANCE.

The additional works maintained and operated in 1901 are the Forbes Hill Reservoir, in Quincy, and the new pipe line to Stoneham.

ORGANIZATION OF MAINTENANCE FORCE.

At the beginning of 1901 the total maintenance force employed directly by the Board was 151, exclusive of such of the engineers as devoted only a part of their time to maintenance. At the end of the year the force had increased to 174. From time to time during the year there has been an additional temporary force engaged on special work, making the maximum number, including both the permanent and temporary force, 230.

RAINFALL AND YIELD.

In the last annual report reference was made to the drought of the summer of 1900, and the statement was made that it ended with the heavy rain of November 24–27.

Owing to the unprecedentedly low rainfall and flow of the streams from January 1 to March 10, this drought, which was partly broken in November, continued until March 10. As an instance of the severity of the drought for this season of the year, the average yield for the month of February on the Sudbury watershed was but 300,000 gallons per day per square mile, against the next lowest record in twenty-seven years of 541,000 gallons, and an average for this period of 1,889,000 gallons.

Immediately following this drought there was a remarkably large rainfall in March, April and May, amounting to 22.40 inches on the Sudbury watershed, or nearly one-half the rainfall for an average year, and a very large flow in the streams. During the summer the rainfall was abundant. In the autumn it was below the average, but in December it was more than double the average. Taking the year as a whole, the rainfall was about 20 per cent. above the average, and the flow from the Sudbury river watershed was 24 per cent. above the average.

Additional statistics relating to rainfall and yield of watersheds may be found in Appendix No. 3, tables 1 to 10.

STORAGE RESERVOIRS.

On January 1 the reservoirs on the Sudbury and Cochituate watersheds contained 8,839,100,000 gallons of water, or slightly more than one-half their total capacity. Owing to the unusual dryness of the season, already alluded to, the reservoirs, instead of rising, continued to lower until March 4, when they contained 7,075,700,000 gallons of water, and their low level at so late a date gave rise to apprehension that they would not be filled; but the succeeding heavy rains, beginning March 10, not only filled the reservoirs early in April, but furnished a large surplus to be wasted.

The reservoirs remained full until the latter part of June, when the storage decreased gradually to November 24, at which time there were 10,767,500,000 gallons of stored water in the reservoirs. From this time to the end of the year the storage increased.

The following table gives the quantity of water in the storage reservoirs at the beginning of each month. The second column gives the total in the reservoirs from which the supply is usually taken, the third column the storage in the other reservoirs, and the last column the total storage in all storage reservoirs.

Quantity of Water stored at the Beginning of Each Month.

DATE.	In Sudbury Reservoir and Framingham Reservoir No. 3 (Gallons).	In All Other Storage Reservoirs (Gallons).	Total (Gallons).
January 1, 1901,	5,205,900,000	3,633,200,000	8,839,100,000
February 1,	4,662,100,000	3,920,300,000	8,582,400,000
March 1,	3,555,900,000	3,654,200,000	7,210,100,000
April 1,	7,638,600,000	6,396,700,000	14,035,300,000
May 1,	8,465,200,000	7,544,000,000	16,009,200,000
June 1,	8,535,600,000	7,603,200,000	16,138,800,000
July 1,	8,278,500,000	7,591,500,000	15,870,000,000
August 1,	8,012,300,000	7,314,900,000	15,327,200,000
September 1,	7,766,900,000	6,923,700,000	14,690,600,000
October 1,	6,961,500,000	6,460,900,000	13,422,400,000
November 1,	6,163,800,000	6,129,500,000	12,293,300,000
December 1,	5,337,200,000	5,686,600,000	11,023,800,000
January 1, 1902,	7,127,200,000	6,712,900,000	13,840,100,000

NOTE. — The storage in Dudley Pond is included in this table.

Sudbury Reservoir. — At the beginning of the year the water in Sudbury Reservoir stood at elevation 252.54, which is 6.46 feet below the crest of the dam. The surface fell to elevation 246.90 on March 4, or 12.1 feet below the crest of the dam. The water then began to rise, and reached the level of the crest on April 3 and the top of the flash-boards on April 7. The surface remained near high-water level until June 23, when the draft on the reservoir beginning to exceed the supply, it lowered about 7.5 feet to elevation 252.32 on November 24. The water then began to rise, and reached elevation 257.35 at the end of the year, — 1.65 feet below the crest of the dam.

The Marlborough Brook filter-beds, at the head of one branch of the Sudbury Reservoir, have been in service throughout the year. They filtered all of the water of the brook except for short periods of less than a day each on eight occasions during freshet flows in

March, April, May and December. These filter-beds comprise 8.63 acres of natural and 5.36 acres of artificial beds. In cleaning the former it has been customary, until the present year, to harrow the surface of each of the beds after drying, leaving the dark-colored material upon the beds. During the year this fine organic deposit has been scraped into piles and removed from the beds. A large quantity of small stones has also been thrown out by the process of harrowing, and has been used for riprapping exposed portions of the banks. A similar method is pursued upon the artificial beds, which, however, have a surface of sand free from stones.

It is apparent that some method of renewing the sand surface from time to time must be adopted, in order to keep the depth of the filter-beds intact, and the best method of accomplishing this result is now under consideration. A large amount of work has been done in the way of repairing and improving different portions of the beds. The culvert under Walker Street, just above the settling reservoir, was rebuilt during the summer, at the joint expense of the city of Marlborough and the Commonwealth. Advantage was taken of this rebuilding to enlarge the culvert by adding 2 feet to its width.

Analyses have been made monthly by the State Board of Health of the water before and after passing through the filter-beds, and they show that the water was not purified by filtration to as satisfactory an extent as during the previous year. The average of all the examinations made during the year is as follows: —

[Parts per 100,000.]

	Before Filtration.	After Filtration.
Color (platinum standard),	0.33	0.14
Total residue on evaporation,	16.34	14.30
Loss on ignition,	5.01	-
Free ammonia,	0.1139	0.0505
Albuminoid ammonia,	0.0471	0.0191
Chlorine,	2.15	1.98
Nitrogen as nitrates,	0.2100	0.2147
Nitrogen as nitrites,	0.0074	0.0005
Oxygen consumed,	0.62	0.29
Hardness,	5.6	5.0

A number of improvements have been made around Sudbury Reservoir, principally in the planting of hemlock and white pine trees, rebuilding fences and grading the grounds around Sudbury Dam. Portions of the stable have been rebuilt and the cellar concreted and drained.

Framingham Reservoir No. 3, which derives its supply almost wholly from Sudbury Reservoir, was kept practically full throughout the year, with an extreme range in elevation of about 3 feet. From early in April until the middle of June, during which time the flash-boards were kept in position on the dam, the water was kept as high as possible; but during the remainder of the year it was kept about 1 foot below the crest, to prevent a waste of water from the effect of the wind.

In May a troublesome leak on the line of the old 48-inch pipe connecting Framingham dams Nos. 3 and 1 was repaired. It was necessary to sheet the trench and to use a steam pump to keep the excavation free from water.

Framingham Reservoir No. 2. — Beginning February 18, water was drawn in considerable quantities from this source for the supply of the Metropolitan District, lowering the water in the reservoir until March 9, when it was 7.4 feet below high-water mark. The level then rose rapidly. Except during the period mentioned, the reservoir has been generally full throughout the year.

Framingham Reservoir No. 1 has been kept practically full throughout the year.

Ashland Reservoir. — Water in this reservoir was about 11 feet below high-water mark at the beginning of the year. It rose gradually to about 7.2 feet below high-water mark on March 11, after which the water rose rapidly, and the reservoir remained full to the end of the year.

Hopkinton Reservoir. — Water in this reservoir was about 13 feet below high-water mark at the beginning of the year. Its level rose about 2 feet in the next two months. During the month of March it filled, and remained practically full during the remainder of the year.

Whitehall Reservoir was about 3 feet below high water at the beginning of the year, but by April 24 it had filled, and so remained until November 7, when the waste gate was opened, in order to lower the reservoir in anticipation of the winter and spring freshets. During the past year the old dredge and steamboat at Whitehall Reservoir have been sold and removed.

Farm Pond has been kept full throughout the year. An additional door of iron has been built in the principal gate-house, to give access to the aqueduct embankment which passes through the pond.

Lake Cochituate at the beginning of the year was about 8 feet below high-water level, and remained within a foot of this level until March 12, when it began to rise rapidly. It was full on April 13, and remained practically so until about July 1. After this the amount turned through the aqueduct caused it to lower at an almost uniform rate to a level about 7.5 feet below high water, on November 18. The water then began to rise, and at the end of the year was 2.71 feet below high water. Water was wasted at the outlet dam almost continuously from April 10 to June 11, and for two days at the end of the year.

In connection with the work of improving the Snake Brook Meadow, already described under the head of "Construction," the flow from 1.96 square miles of the Snake Brook watershed was diverted from the lake, in order to diminish as much as possible the amount of water to be pumped in connection with that improvement. In estimating the yield of the watershed allowance has been made for this diversion, and also for the amount of water pumped from the Snake Brook Meadow and diverted from the lake, as already described.

From January 2 to January 22, and from March 21 to April 8, water amounting in all to 543,600,000 gallons was discharged into the lake from the Sudbury Aqueduct.

No water has been drawn from Dudley Pond into the lake during the year. On January 1 the pond was 4.14 and at the end of the year 2.17 feet below high water, the highest point being reached on June 10, when the surface stood 1.42 feet below high water.

The Pegan Brook filter-beds in Natick have been in use for 278 days during the year. All of the brook water was filtered, except for portions of three days, when a small amount of water overflowed the settling reservoir and passed into the lake. At these times, however, freshets too large for the pumps to handle were passing down the brook, and the water was comparatively pure. The total quantity of water pumped from Pegan Brook during the year was 295,261,000 gallons; the total amount of coal consumed was 304,414 pounds, — making 970 gallons of water pumped per pound of coal.

SOURCES FROM WHICH WATER HAS BEEN TAKEN.

During the year the only water supplied from local sources was 21,200,000 gallons drawn by the city of Medford from Wright's Pond, and 193,400,000 gallons supplied by the Wakefield Water Company to the town of Stoneham, before it received water from the Metropolitan Water System on October 21, making in all an average of 588,000 gallons per day for the whole year from local sources. All of the supply, except this small quantity, was furnished by the Metropolitan Works, which furnished an average of 100,904,000 gallons per day. An average of 64,299,000 gallons per day was drawn from the South Branch of the Nashua River through the Wachusett Aqueduct into the Sudbury Reservoir. An average of 84,930,000 gallons per day was drawn through the Sudbury Aqueduct from Framingham Reservoir No. 3, which obtains its supply mainly from the Sudbury Reservoir. An average of 5,398,000 gallons per day was drawn from Framingham reservoirs Nos. 1 and 2, which receive all of the water supplied by the main Sudbury River. Of the water drawn from the Framingham reservoirs, an average of 1,489,000 gallons per day was turned into Lake Cochituate. An average of 14,890,000 gallons per day was drawn from Lake Cochituate.

The utmost care is taken to draw as little water as possible from the less satisfactory sources, and to draw the water only at such times as it is in good condition; but the maintenance of the supply with the existing condition of the works and the large consumption of water makes it necessary to draw some of the water from the less desirable sources.

It may be noticed that the total quantity of water passing into the Metropolitan District through the aqueducts is, according to the figures above given, somewhat in excess of the amount of water supplied from the Metropolitan Works to the District. In 1901, for the first time, all of the water for the District has been pumped, and the pump measurement, with a small allowance for slip, is used in determining the quantity. The quantities flowing through the aqueducts were determined by less exact methods, and are somewhat in excess of the actual quantity, but sufficiently accurate for indicating the proportion of water obtained from different sources.

AQUEDUCTS.

The *Wachusett Aqueduct* has been in continuous use throughout the year, except for twenty-five days, — April 4 to 15, April 24 to 29, May 28 to 30, December 15 to 21, and December 30 and 31, — when the water was quite turbid and not of a satisfactory quality to send through the aqueduct. During the time that there was no water running in the aqueduct, early in April, it was cleaned inside for its entire length. The average daily flow for the whole year has been 64,248,000 gallons per day.

Early in March alterations were made to the small flume and to the head works of the same at the temporary dam, so that 175,000,000 gallons of water per day could be sent through the aqueduct; and this flow has been generally maintained when there was sufficient water of good quality running in the river. Previous to the alterations, it was possible to send only about 130,000,000 gallons per day through the aqueduct.

From January 1 to March 11, March 16 to March 21, June 14 to October 14, and from October 20 to December 12, substantially all of the water in the river was turned through the aqueduct, except that which the provisions of the Metropolitan Water Act require shall be permitted to flow down the river, and a further quantity which filters into the excavation for the main dam and is pumped into the river below the dam.

The usual work of maintenance along the line of the aqueduct has been performed, and the aqueduct and its appurtenances are in excellent condition.

The *Sudbury Aqueduct* was in constant service during the year, except on the few occasions when it was necessary to empty it for cleaning. The total flow for the whole year averaged 90,328,000 gallons per day, which is 4,461,000 gallons more than the daily amount of water carried by the aqueduct last year. The interior was cleaned from Farm Pond gate-house to the terminal chamber at Chestnut Hill Reservoir, April 12, 18 and 25 and May 2. The siphon pipes were cleaned at the same time. The interior of the aqueduct was covered with a thick coating of black slime for its entire length. Sponge in small quantities was found in the Farm Pond gate-house, and gradually increased in quantity to the Rockland Street tunnel, where the bottom was entirely covered, as were also the sides from 2 to 4 feet in height. Badger Hill tunnel was in like condition. From the Badger Hill tunnel to the Beacon Street tunnel sponge was found in varying quantities, but in the Beacon Street tunnel no sponge was found.

The stairway at Echo Bridge over the Charles River has been completed and the grounds graded.

During the year the city of Newton laid a main sewer in tunnel through the rock on each side of the Charles River, passing beneath the large arch at Echo Bridge in the bed of the river in two siphon pipes. A large amount of blasting was done on each side of the bridge, requiring special care to prevent ill effects on the masonry of the bridge. Advantage was taken of the drawing down of the water in the Charles River at this time to examine carefully the condition of the foundations upon which the abutment of the large arch of Echo Bridge rests. On the easterly side of the stream the ledge is not of very good character, and a retaining wall was built to aid in securing its stability.

New fencing 8,640 feet in length has been built along the line of the aqueduct, and 10,912 feet of old fence have been repaired.

The interior of the arches at Waban Bridge were heated with steam during the winter months, which prevented the formation of ice inside the bridge.

As the aqueduct is run much of the time to its full capacity, great care has to be taken to prevent it from being overcharged. As additional precautions to those previously provided, a recording float gage to indicate the depth of the water in the aqueduct has been installed at the South Framingham office, and a telephone has been placed in the gate-house at Framingham Dam No. 1. The flows in the aqueduct have been checked frequently throughout the year by current meter measurements.

The *Cochituate Aqueduct* was in use about three hundred and seven days. Advantage was taken of the opportunity between May 7 and June 11, when the aqueduct was not in use, to continue the repairs of cracks in the aqueduct on embankments. Last year they had been completed from the upper end of the aqueduct to and including Seaver's embankment, easterly from the Waban station in Newton. All of the cracks easterly from this point, as far as the Newton Centre waste weir, were repaired, also the cracks in the top of the aqueduct as far as Homer Avenue, about 1,400 feet easterly from the waste weir.

The interior of the aqueduct was cleaned for its whole length on May 9, 10 and 11. The brickwork was covered with a black slime for its entire length, and sponge was found in large quantities from the lake to Stevens' Brook, gradually diminishing from this point to Chestnut Hill Reservoir.

New flap-gates of kyanized lumber were placed in position at the outlet pipe chamber on the two 30-inch and the 36-inch siphon pipes. Quite extensive repairs have been made on the exterior stone work of the structures connected with the aqueduct.

The channel of Snake Brook was cleaned for a distance of 2,400 feet near the village of Cochituate, where the brook passes over the line of the aqueduct. For the purpose of diverting the waters of the brook from the lake, a dam containing a plank sluiceway was built across the aqueduct. This work was done in connection with the excavation of Snake Brook Meadow, described under the head of "Construction."

The aqueduct line has been crossed several times during the year by small culverts and water pipes and telephone conduits.

Pumping Stations.

With the exception of 102,980,000 gallons of water drawn by the city of Boston from the Brookline Reservoir, while one of its 48-inch pipe lines was being repaired, all of the water supplied by the Metropolitan Water Works during the year has been pumped at the two stations at Chestnut Hill Reservoir.

The supply for the northern high-service district is again pumped at Spot Pond to the Fells Reservoir, and the supplies for the southern extra high-service district in West Roxbury and the northern extra high-service district in Arlington are pumped a second time at the small stations in West Roxbury and Arlington.

On account of the unavoidable discontinuance — mentioned in last year's report — of the pipes supplying the high-service district of Breed's Island in East Boston, the old pumping station in East Boston belonging to the city of Boston was operated by the Board until June 20.

The present daily pumping capacity of the five stations operated by the Board is 204,500,000 gallons, and the force employed in these stations numbers 48.

The total quantity pumped at all of the stations during the year was 40,018,920,000 gallons, and the cost of operating the stations was $100,650.94, equivalent to $2.52 per million gallons pumped. This is $0.82 per million gallons less than for the preceding year, due to the large increase in the quantity pumped for the low service, and to the use of more economical machinery.

The saving effected in the cost of pumping by the discontinuance of the many small stations which were operated in the several cities and towns previous to 1898 and by pumping the supply with more economical machinery at a few large stations is illustrated by the following statement: —

	Cost of Pumping.	Million Gallons Pumped.	Cost per Million Gallons.
1897,	$122,400 00	12,700	$9 64
1901,	100,650 94	40,019	2 52

Chestnut Hill High-service Station.

The engines at this station have pumped the supply for the high-service district of Boston, also the entire supply of the city of Quincy and the towns of Watertown and Belmont. Engines Nos. 1, 2 and 3 have also been used to pump a small portion of the low-service supply. The 30,000,000-gallon Allis engine pumped 80.6 per cent. of the entire quantity pumped at the station.

The following are the statistics relating to the operations at this station: —

	LOW SERVICE.		HIGH SERVICE.			Totals.
	Engines Nos. 1 and 2.	Engine No. 3.	Engines Nos. 1 and 2.	Engine No. 3.	Engine No. 4.	
Total quantity pumped (million gallons),	204.51	645.58	202.47	1,016.57	8,584.11	10,653.24
Total coal used (pounds),	810,069	482,009	499,756	958,488	6,346,061	8,591,383
Gallons pumped per pound of coal,	1,077.18	1,478.94	608.13	1,102.38	1,352.67	1,239.99
Average head pumped against (feet),	48.18	67.77	124.33	125.25	126.31	121.13
Cost of pumping: —						
Labor,	$788 27	$945 92	$680 61	$1,576 53	$11,823 98	$15,765 31
Fuel,	594 40	924 01	958 03	1,827 84	12,165 86	16,470 14
Repairs,	485 00	442 00	485 00	834 59	2,092 37	4,338 96
Oil, waste and packing,	30 00	50 00	30 00	100 00	557 37	767 37
Small supplies,	48 92	65 22	48 92	97 83	554 39	815 28
Total for station,	$1,946 59	$2,427 15	$2,152 56	$4,436 79	$27,193 97	$38,157 06
Cost per million gallons pumped to reservoir,	$9 518	$3 760	$10 632	$4 364	$3 168	$3 582
Cost per million gallons raised 1 foot high,	198	055	086	035	025	030

Coal has been purchased for use at this station as follows: 3,981.25 gross tons bituminous coal, at an average price of $4.45 per ton; 545.63 gross tons anthracite coal screenings, at an average price of $2.25 per ton.

The cost per million gallons raised 1 foot high was $0.03, which is almost exactly the same as the cost for the previous year. As the quantity pumped at this station was about 33 per cent. less than during 1900, and as the cost of coal was $0.57 per ton greater, the result is a satisfactory one.

At the beginning of the year two horizontal tubular boilers were being set in the boiler room, replacing two boilers installed with the Gaskill engines in 1885. The new boilers are designed to carry 185 pounds of steam pressure, so that they can be used in connection with any of the engines in the station. The boilers were placed, the brick setting built and all of the small piping done by the regular maintenance force. The steam piping connecting with other boilers and with engines Nos. 1 and 2 was done by the William H. Gallison Company, at a cost of $1,365.71. Magnesia covering was applied to the piping by S. C. Nightingale & Childs, at a cost of $210. The work was completed and the boilers placed in service on March 23.

A new toilet room with slate partitions and modern fixtures has been built in the basement, and connections made with the new sewer built in 1900. This work was done by James Tucker & Sons, at a cost of $745.

The Belpaire boiler which was added to the plant in 1894 has for a number of years given considerable trouble on account of cracks in the side furnace plates, and after careful consideration it has been decided to replace this boiler by two vertical boilers of the same design as those in use at the low-service and Spot Pond stations. Plans are now being made, and the boilers will be built during the coming year.

The exterior woodwork of the building has been painted, the interior oak finish of the engine room varnished and the floor cleaned and varnished. In order to strengthen engine No. 4, the Allis-Chalmers Company has at its own expense placed five cast-steel supports between the pump chambers and the under side of the engine bed-plates.

Chestnut Hill Low-service Station.

The three 35,000,000-gallon engines at this station have pumped a daily average for the entire year of 72,204,000 gallons, or 71 per cent. of the total consumption of the municipalities supplied by the Metropolitan Works. They have continued to operate very satisfactorily, and both engines and boilers are now in good condition.

The following are the statistics relating to operations at this station: —

	Engines Nos. 5, 6 and 7.
Total quantity pumped (million gallons),	26,354.40
Total coal used (pounds),	8,528,670
Gallons pumped per pound of coal,	3,090.09
Average head pumped against (feet),	48.37
Cost of pumping: —	
Labor,	$20,319 34
Fuel,	16,916 36
Repairs,	432 41
Oil, waste and packing,	854 83
Small supplies,	1,065 03
Total for station,	$39,587 97
Cost per million gallons pumped to reservoir,	$1 502
Cost per million gallons raised 1 foot high,	031

Bituminous coal for use at the station has been purchased as follows: —

Loyal Hanna Coal and Coke Company,	471.78 gross tons, at $4.78 per ton.
Loyal Hanna Coal and Coke Company,	977.26 gross tons, at $4.29 per ton.
Loyal Hanna Coal and Coke Company,	2,401.30 gross tons, at $4.34 per ton.

Spot Pond Pumping Station.

At this station engine No. 8 was operated a few days in February; twelve days in May, while arrangements were being made for the official trial of engine No. 9, and from September 10 to October 11, while engine No. 9 was being painted. With these exceptions the new Holly engine has pumped all of the water at this station. As a rule it is operated only in the day time.

The following are the statistics relating to operations at this station: —

	Engine No. 8.	Engine No. 9.	Totals.
Total quantity pumped (million gallons),	351.89	2,414.53	2,766.42
Total coal used (pounds),	344,975	2,076,021	2,420,996
Gallons pumped per pound of coal,	1,020.04	1,163.06	1,142.68
Average head pumped against (feet),	114.54	119.50	118.87
Cost of pumping: —			
Labor,	$1,024 51	$6,564 43	$7,588 94
Fuel,	678 99	4,086 03	4,765 02
Repairs,	15 03	15 03	30 06
Oil, waste and packing,	54 74	218 98	273 72
Small supplies,	144 66	578 66	723 32
Total for station,	$1,917 93	$11,463 13	$13,381 06
Cost per million gallons pumped to reservoir,	$5 450	$4 748	$4 837
Cost per million gallons raised 1 foot high,	048	040	041

Coal for use at the station has been purchased as follows: —

Locke Coal Company (bituminous),	1,000.05 gross tons, at $4.37 per ton.
Locke Coal Company (anthracite screenings),	13.14 net tons, at $2.00 per ton.

West Roxbury Pumping Station.

During the past year both the pumps and boilers at this station have been replaced by others of larger capacity. The two new pumps have each a capacity of 1,000,000 gallons in twenty-four hours, and are of the compound duplex type, built by the Henry R. Worthington Company of New York. They were purchased from the city of Boston, having been formerly used in the East Boston pumping station. Two new boilers, 54 inches in diameter and 9 feet high, containing 184 2-inch tubes, 6½ feet long, were furnished by E. Hodge & Co. of East Boston. A Wainwright surface condenser, 16¼ inches in diameter and 7 feet 4 inches long, and a Snow single air pump, 4 inches by 4¾ inches by 8 inches, were also added to the plant. The old pumps and boilers were removed and the new plant installed without interrupting the regular operation of the station, the work being all done by the regular employés of the department. The boilers were delivered June 10, and the work was completed during the latter part of July. The old pumps and boilers belonging to the city of Boston were returned to the Boston Water Department yard.

The following are the principal items of cost of the work: —

Two pumps,	$400 00
Two boilers,	1,197 66
Air pump,	126 00
Surface condenser,	210 00
Covering boilers and piping,	93 78
Teaming pumps and boilers,	59 00
Piping and valves,	198 34
Labor taking out old and installing new pumps and boilers,	891 79
Miscellaneous,	193 69
Total,	$3,370 26

A saving of between 30 and 40 per cent. of the coal burned has been made by installing the new pumps and boilers.

In November, the boilers, engines and piping were painted, the interior woodwork of the building varnished and the outside woodwork painted.

The following are the statistics relating to operations at this station: —

Daily average quantity of water pumped (gallons),	334,000
Daily average quantity of coal consumed (pounds),	1,834
Gallons pumped per pound of coal,	182
Average lift in feet,	135
Cost of pumping: —	
Labor,	$2,850 60
Fuel,	1,961 00
Repairs and small supplies,	109 97
Total for station,	$4,921 57
Cost per million gallons pumped to reservoir,	$40 310
Cost per million gallons raised 1 foot high,	299

Arlington Pumping Station.

The supply for the high-service district of the town of Arlington is pumped at this station.

The following are the statistics relating to operations at this station: —

Pumps operated 4,379 hours 45 minutes; average, 12 hours per day.

Daily average quantity of water pumped (gallons),	309,000
Daily average quantity of coal consumed (pounds),	1,746
Gallons pumped per pound of coal,	177
Average lift in feet,	278
Cost of pumping: —	
Labor,	$2,077 22
Fuel,	1,199 13
Repairs and small supplies,	144 68
Total for station,	$3,421 03
Cost per million gallons pumped to standpipe,	$30 340
Cost per million gallons raised 1 foot high,	109

The quantity pumped was 1.7 per cent. greater than for the previous year, and the cost per million gallons pumped to the standpipe was very nearly the same.

East Boston Pumping Station.

The supply for the small district on Breed's Island was pumped at the East Boston station belonging to the city of Boston from January 1 to June 20, when the work of relaying pipes in Bennington Street was completed, so that the supply could be taken from the Fells Reservoir.

The cost of operating this station was $731.25.

CONSUMPTION OF WATER.

The daily average quantity of water consumed in the cities and towns of the Metropolitan Water District supplied wholly or in part by the Metropolitan Water Works during the year 1901 was 101,492,000 gallons, equivalent to 120 gallons per inhabitant in the district supplied. Of the above, 100,904,000 gallons per day were supplied by the Metropolitan Water Works and 588,000 gallons per day from local sources. The increase in the daily average consumption in the cities and towns supplied over that of the previous year was 6,742,000 gallons, or 7.1 per cent. During the summer months the consumption was but little greater than for the corresponding months of the previous year, due in great measure to the large amount of rainfall. During the months of January, February and December, however, the consumption averaged 15,000,000 gallons per day more than during the corresponding months of the year 1900. This was due in great measure to the colder weather during these months in 1901.

The consumption and percentage of increase over the previous year in the several districts was as follows: —

	Gallons per Day.	Percentage of Increase.
Southern low-service district, embracing the low-service district of Boston, with the exception of Charlestown and East Boston, ...	39,754,000	2.2
Northern low-service district, embracing the low-service districts of Somerville, Chelsea, Malden, Medford, Everett, Arlington, Charlestown and East Boston, ...	26,501,000	11.4
Southern high-service district, embracing the high-service district of Boston, Quincy, Watertown and Belmont, ...	26,496,000	10.3
Northern high-service district, embracing Melrose, Revere, Winthrop, Swampscott, Nahant and Stoneham, and the high-service districts of Somerville, Chelsea, Malden, Medford, Everett and East Boston, ...	8,096,000	18.0
Southern extra high-service district, embracing the highest portions of West Roxbury, ...	334,000	—6.0
Northern extra high-service district, embracing the highest portions of Arlington, ...	309,000	1.3

The percentages of increase given above do not in all cases accurately represent the increase in the per capita consumption, because changes were made in the boundaries of the districts. In May, 1900, portions of Roxbury and West Roxbury were changed from low to high service. This affects slightly the percentages of increase given for the southern low and southern high services. The water used in Stoneham during 1901 is included in the consumption of the northern high-service district, but it was not included for the year 1900. If the consumption of Stoneham is included in that of the northern high-service district in 1900, the percentage of increase would be 9.3, instead of 18. The decrease in the consumption in the southern extra high-service district was due in part to the transfer of a number of water takers to a lower service, and in part to a too small allowance for slip in the pumps for the year 1900.

Detailed statistics of the consumption of water may be found in Appendix No. 3, tables 20 to 26.

QUALITY OF THE WATER.

Samples of water were collected every two months from eight points, monthly from eight points and weekly from three points upon the works, and sent to the State Board of Health for analysis and examination. Samples of water were also collected each week from many points upon the works, and examined microscopically and for color, odor, taste and turbidity by the biological force of the Metropolitan Water and Sewerage Board.

The quality of the water furnished was about the same as that of the previous year. The average color was exactly the same. As far as shown by the chemical examinations by the State Board of Health, the tap water of the main portion of the Metropolitan supply was not quite as good, while as far as concerns freedom from microscopical organisms, shown by the examinations under the direction of the Metropolitan Water and Sewerage Board, the water was better. The mineral constituents and hardness of the water were considerably in excess of the previous year, but this excess has much less significance than if it occurred in the organic matter.

Although a larger supply was furnished to the Metropolitan District, due to increased consumption, a smaller proportion of water was drawn from Framingham Reservoir No. 2 and Lake Cochituate, which are generally less satisfactory sources than Framingham Reservoir No. 3 and Sudbury Reservoir, from which the main supply was taken. The latter receive the greater part of their water from the Nashua River, and other things being equal, the quality of the water in the main part of the distribution system should have been better than that for the previous year.

The amount and distribution of the rainfall, however, were such that the quality of the water flowing in the streams was not quite so good during 1901 as in 1900. In the year 1900, owing to the drought, the flow in the main channel of the Sudbury River was very small, and consequently it was feasible to run the stored water from the Ashland and Hopkinton reservoirs into Framingham Reservoir No. 2 with only a small admixture with the less satisfactory river water. In this way a water of satisfactory quality was supplied to and drawn from Framingham Reservoir No. 2 until the latter part of February, 1901, but after the heavy rains began, in March, and during the remainder of the year, the flow in the river was so large that the stored water from the upper reservoirs could not be turned into Framingham Reservoir No. 2 except with a large admixture of river water, which was not of satisfactory quality, consequently no water was drawn from these reservoirs during the year. During the past year, also, the waters supplied to the Sudbury Reservoir and to Framingham Reservoir No. 3 from the Sudbury River watershed, and also the water supplied to Lake Cochituate from the Cochituate watershed, were not of as good quality as during the previous year.

The following table gives a comparison of the average results of examinations of Boston tap water made for the years 1897, 1898, 1899, 1900 and 1901. The additional supply from the South Branch of the Nashua River first reached the Metropolitan District about May 1, 1898.

	1897.	1898.	1899.	1900.	1901.
State Board of Health Examinations.					
Color (Nessler standard),	0.65	0.41	0.28	0.24	0.24
Total residue,	4.82	4.19	3.70	3.80	4.43
Loss on ignition,	1.84	1.60	1.30	1.20	1.64
Free ammonia,	0.0009	0.0008	0.0006	0.0012	0.0018
Albuminoid ammonia, total,	0.0193	0.0152	0.0136	0.0157	0.0158
Albuminoid ammonia, dissolved,	0.0177	0.0136	0.0122	0.0138	0.0143
Albuminoid ammonia, suspended,	0.0016	0.0016	0.0014	0.0019	0.0015
Chlorine,	0.40	0.29	0.24	0.25	0.30
Nitrogen as nitrates,	0.0137	0.0097	0.0137	0.0076	0.0173
Nitrogen as nitrites,	0.0001	0.0001	0.0001	0.0001	0.0001
Oxygen consumed,	0.64	0.44	0.35	0.38	0.42
Hardness,	1.6	1.4	1.1	1.3	1.7
Metropolitan Water and Sewerage Board Examinations.					
Color (platinum standard),	0.59	0.40	0.32	0.34	0.34
Total organisms,	351	230	192	468	243
Amorphous matter,	177	131	201	97	38
Bacteria,	105	96	117	181	162

NOTE. — Chemical analyses are in parts per 100,000, organisms and amorphous matter in standard units per cubic centimeter, and bacteria in number per cubic centimeter. The standard unit has an area of 400 square microns, and by its use the number of diatomaceæ are decreased, and the number of chlorophyceæ and cyanophyceæ are very much increased, as compared with the number of organisms.

The filling of Spot Pond from the Sudbury and Cochituate sources, referred to in the last report, had been interrupted in December, 1900, by drought, but was resumed in the spring of 1901, and on April 9 the pond was entirely full. From April 9 until the beginning of the summer the water in Spot Pond contained a considerable number of microscopical organisms, but it improved rapidly during the summer, and under the influence of storage it became the best water in the Metropolitan system. The color was reduced to .08 on the platinum scale, which was about one-third of the color of the main supply at the same time, and the organisms were few in number. The water was accordingly used as far as practicable, but in the autumn the microscopical organisms increased to such a degree as to give a slightly unpleasant taste and odor to the water, and on December 12 the pond was shut off from the supply.

Appendix No. 3, tables 27 to 35, gives the detailed results of chemical, microscopical and bacterial examinations of water from various parts of the Metropolitan Water Works.

BIOLOGICAL LABORATORY.

On December 24 Mr. Horatio N. Parker, chief biologist, resigned to accept a position in New Jersey, his resignation to take effect January 1, 1902.

During the year 2,954 microscopical and 1,249 bacterial examinations of water were made at the laboratory of the Metropolitan Water and Sewerage Board, at No. 1 Ashburton Place, Boston. Of the microscopical examinations, 2,121 were of the regular weekly samples and 473 were made in connection with special examinations. During the whole of the past year and during the last three months of the preceding year, in addition to the usual observations, the odors of the water, cold and hot, were observed and classified with reference to strength and character. Their strength is indicated by a series of numbers ranging from 0 to 5, or from no odor to a very strong odor. The character of the odor is classified under 16 different heads.

The turbidity of the water was also measured by comparing the samples with a standard consisting of diatomaceous earth suspended in water in which a turbidity of 1 is represented by 1 part of diatomaceous earth in 1,000,000 parts by weight of distilled water.

Some advance has been made every year in the way of refinement of methods used in the laboratory. Information promptly obtained and reported, relative to the character of the water and the organic growths which it contains, is of great value in the management of the works, as it furnishes a guide for making changes in the method of drawing water so as to obtain the best results.

The principal results of the work done by the biological force are given in Appendix No. 3. Table No. 34 gives the results of the microscopical examinations, Table No. 35 the bacterial examinations, Table No. 36 the turbidity, Table No. 37 the colors of the water, and tables Nos. 38 and 39 the temperatures of the water and of the air.

SANITARY INSPECTION.

The sanitary inspection of the Sudbury, Cochituate and Wachusett watersheds has been continued during the year under the direction of William W. Locke, C.E., sanitary inspector. The greater part of the inspection has been done upon the Sudbury and Cochituate watersheds, where there is a large population, but a much larger amount of work than heretofore has been done on the Wachusett watershed, and the results obtained continue to be very satisfactory.

A summary of the work done in 1901 upon the Sudbury and Cochituate watersheds is given in the accompanying tables. The first table shows the number of premises inspected, the classification of cases inspected and the condition of the premises at the end of the year. The headings of this table explain themselves, except in a few instances; under the heading "Suspected" are included all cases where positive information could not be obtained, and where it is suspected that there may be some objectionable drainage; under the heading "Premises Vacant" are included all cases which at present furnish no objectionable drainage, but which might furnish such drainage if the premises were occupied; under the heading "Unsatisfactory" are included all cases where there may be, under the most unfavorable conditions, wash from privies or direct sink drainage, all suspected cases and all cases of manufacturing wastes entering feeders, even though there may be some attempt at previous purification.

The second table shows the improvements effected in 1901. No cases are entered as remedied unless complete sewer connections have been made or all probability of future contamination has been removed, and no cases are entered as partly remedied except where positive improvement in the sanitary condition has been effected.

Summary of Sanitary Inspections in 1901.

DISTRICT.	Number of Premises inspected.*	CLASSIFICATION OF CASES INSPECTED.									CONDITION AT END OF YEAR.	
		Cesspools dug before 1901.	Cesspools dug in 1901.	Direct Privy Drainage.	Indirect Privy Drainage.	Direct Sink Drainage.	Indirect Sink Drainage.	Manure Piles.	Manufacturing Wastes.	Premises Vacant.	Satisfactory.	Unsatisfactory.
Sudbury Watershed.												
Farm Pond,	3	1	-	-	-	-	1	1	-	-	3	-
Framingham Reservoir No. 3,	7	5	1	-	-	-	1	2	-	1	7	-
Stony Brook,	53	31	-	-	-	2	5	7	1	8	48	5
Angle Brook,	391	200	7	-	3	9	68	28	5	35	345	46
Framingham reservoirs Nos. 1 and 2 and Cold Spring Brook,	26	19	-	-	-	-	5	2	-	2	24	2
Eastern Sudbury,	36	17	1	-	-	-	12	1	-	10	32	4
Indian Brook,	48	25	-	-	-	-	16	3	-	3	36	12
Western Sudbury,	22	12	1	-	-	-	8	2	1	2	18	4
Whitehall Reservoir,	7	3	-	1	-	1	1	3	-	-	5	2
Cedar Swamp,	56	27	1	-	-	-	8	-	1	2	50	6
Cochituate Watershed.												
Snake Brook,	38	17	3	-	1	-	12	4	-	3	31	7
Pegan Brook,	169	65	1	-	2	-	10	11	3	4	155	14
Course Brook,	6	3	-	-	-	-	2	-	-	-	4	2
Beaver Dam Brook,	119	60	1	-	1	4	18	7	7	4	100	19
Totals,	981	485	16	1	7	16	167	71	18	74	858	123

* Not including a large number of premises which were found on examination to be in a satisfactory sanitary condition, and likely to remain so. On some premises there are two or more cases.

Sanitary Improvements effected on the Sudbury and Cochituate Watersheds in 1901.

DISTRICT.	Remedied by Sewer Connections.	Otherwise remedied.	Partly remedied.	Cesspools abandoned on Account of Sewer Connections.
Sudbury Watershed.				
Farm Pond,	-	-	-	-
Framingham Reservoir No. 3,	-	-	1	-
Stony Brook,	-	-	-	-
Angle Brook,	44	4	7	47
Framingham reservoirs Nos. 1 and 2 and Cold Spring Brook,	-	-	-	-
Eastern Sudbury,	-	-	1	-
Indian Brook,	-	-	-	-
Western Sudbury,	-	-	1	-
Whitehall Reservoir,	-	-	-	-
Cedar Swamp,	17	-	1	17
Cochituate Watershed.				
Snake Brook,	-	-	2	-
Pegan Brook,	73	1	-	71
Course Brook,	-	-	-	-
Beaver Dam Brook,	28	5	1	25
Totals,	162	10	14	160

In towns containing sewers, the making of sewer connections has been pushed through the agency of the local boards of health, with satisfactory results.

In Natick 73 old houses have been completely plumbed and connected with the public sewers, — about the same number as during each of the past two years. The area of the sewered districts is being increased each year by the building of new sewers.

In Marlborough there has been a falling off in the number of sewer connections, as compared with the previous year, 44 houses having been completely plumbed and connected with the sewers the past year, against 58 the previous year.

In South Framingham 28 houses have been completely plumbed and connected during the past year, as compared with 14 during the previous year. The new low-level sewer along Beaver Dam Brook has been completed only from the sewerage pumping station to Irving Street, and until this sewer is extended it will not be available for any large part of the district which it is intended to serve. Only 3 houses have been connected with the sewer up to the present time.

In Westborough 17 sewer connections have been made, against 12 the previous year.

The sanitary inspection of the Wachusett watershed, which is connected with both the construction and maintenance of the work, has been reported upon under the head of "Construction."

DRAINAGE OF SWAMPS.

No additional ditches for the drainage of swamps have been constructed during 1901. The ditches previously constructed by the Dam and Aqueduct Department on the Wachusett watershed and on the part of the Sudbury watershed tributary to the open channel have been maintained by the maintenance force of the Dam and Aqueduct Department. It has required most of the time of two men to take care of the 15.55 miles of ditches on the Sudbury watershed.

Observations of the color of water from Crane Swamp and from the swamp southwest of Marlborough Junction before and after draining were given in the last annual report. The average colors of the waters issuing from these swamps in 1900 were, respectively, .82 and .47; for the year 1901 the average colors were, respectively, 1.04 and .66. The higher colors in 1901 are due to the larger amount of rainfall in the warmer part of the year. The colors in 1901 were a little less than one-half the colors in 1894–95, before the swamps were drained.

The ditches built by the Sudbury Department were finished so late in the season of 1900 that no opportunity was afforded for protecting the sides of the ditches above the paving by seeding or sodding, and a considerable amount of damage was done by the frost and the heavy flows of water in the spring. The wooden bottoms of the ditches were not disturbed, but much damage was done to the paving and earth work at the sides. In the summer, extensive repairs were made. In some places the work could be done rapidly by ramming the paving back into place and sodding the banks, but in other places much more work was required.

DISTRIBUTING RESERVOIRS.

The distributing reservoirs maintained by the Board are the Chestnut Hill Reservoir, Waban Hill Reservoir and Forbes Hill Reservoir and standpipe, of the southern high-service system; Spot Pond and the Mystic Distributing Reservoir near Tufts College, of the low-service system; the Fells Reservoir, of the northern high-service system; and the Arlington standpipe, of the northern extra high-service system.

Chestnut Hill Reservoir.

A much-needed improvement has been made to the surface water drains in the vicinity of the intermediate gate-house. The old pipes were not large enough to carry the heaviest rainfalls, and nearly 600 feet of drain pipe from 6 inches to 12 inches in diameter were laid, 5 catch-basins remodelled or rebuilt, and a new catch-basin and a new man-hole built. The drain can now take care of a rainfall of 2 inches per hour.

A large amount of surfacing of the driveways around the new low-service pumping station was done early in the year by the force in charge of the reservoir. Extensive repairs have been made upon the window frames and roofs of several of the gate-houses, and the usual care has been bestowed upon the maintenance of the reservoir and surrounding grounds.

Waban Hill Reservoir.

The slope paving on two sides of this reservoir, which had settled so as to be unsightly in appearance, has been relaid for from 10 to 20 feet down from the top of the slope, and the masonry of the gate-house and entrance steps repointed. A considerable portion of the reservoir embankments was reseeded. The reservoir was kept full of water, but shut off from the system for the greater part of the year.

Forbes Hill Reservoir and Standpipe.

The reservoir was placed in service on September 23, 1901; the stand-pipe has been in use during the whole year, and is in good condition.

Spot Pond.

On January 1, 1901, the elevation of the surface of the water in the pond was 159.47 feet above Boston city base, or 3.53 feet below high-water mark. It was kept near this level until early in the month of March, when water was pumped into the pond; and on April 9 the surface reached elevation 163, or high-water mark. The pond was kept full until the middle of September, when it was lowered about 2 feet, in order to facilitate the work of pipe laying in Pond Street. About October 13 it was again raised, reaching elevation 163 on November 12. Early in December the water in the pond acquired an objectionable taste and odor, from the presence of microscopic organisms, and since December 12 no water has been drawn from the pond for supplying the district. Some repairs have been made to the riprap and gravel beaches on the shore of the pond, the trees have been cared for, drains cleaned, and nine tons of straw harvested for the use of the department.

Mystic Reservoir.

The embankments were fertilized in the spring. Screens have been placed in what was formerly the inlet to the reservoir, as the supply for Arlington is at times drawn from the reservoir at this point.

Fells Reservoir.

This reservoir has been in constant use, and has been kept near high-water mark, with the exception of periods of about two weeks in the latter part of the month of April, while the reservoir was being cleaned, and three weeks following May 22, when arrangements for measuring over a weir the quantity of water pumped necessitated lowering the height of the water. Between April 16 and May 1 both basins of the reservoir were emptied and cleaned, at a cost of $468.87.

MYSTIC LAKE.

Two buildings formerly used for a temporary pumping station have been leased to the Medford Boat Club, and one of the storehouses has been torn down. One man has been employed to look after the grounds and to control the height of water in the lake.

PIPE YARDS.

At the Glenwood pipe yard the outside woodwork of the office and stable building was painted, and portions of the walls were pointed. The mast of the derrick was fitted with truss rods, in order to strengthen it for handling 60-inch pipe.

At the Chestnut Hill pipe yard a platform scale has been set up. The exterior woodwork of the stable has been painted, also the interior finish in the carriage room.

PIPE LINES.

At the close of the year there were 72 miles of pipe lines controlled by the Board. During the year 3 breaks and 30 leaks have been repaired, at a cost of $2,699.63. Two of the breaks and 3 of the leaks were in Somerville, on mains taken from the city of Boston; 16 of the leaks occurred at the joints of the 36-inch submerged pipes under the Charles and Mystic rivers. Similar leaks occurred last year in the autumn, and they are caused by the contraction of the pipes, due to the falling temperature at this season of the year. In November the 36-inch pipes crossing the Charles River near Magazine Street in Cambridge were tested and found to be leaking. Examination by diver disclosed 2 leaks, and after these were repaired others were found. As the pipes are buried several feet below the surface of the river bed, a dredge was required for excavating the earth around the pipes before the diver could reach the joints, and the work of making repairs was slow and expensive. Work was continued from November 26 to December 31, 6 leaks having been repaired, at a cost of $1,790.

The leaks at the Mystic River crossing between Somerville and Medford were repaired by the regular maintenance force, as they could be reached during extreme low tide without the services of a diver.

The construction of the tunnel under the channel of the Mystic River between Charlestown and Chelsea, in which to place a 24-inch pipe, was begun by C. W. Haskin on August 20, 1900, and at the beginning of 1901 one shaft and the greater portion of the tunnel were finished. The second shaft and the remainder of the tunnel were completed about the middle of February, and the pipes were laid by the maintenance force and placed in service March 15. Both shafts and tunnel are 6 feet internal diameter, with walls of 12-inch brick masonry laid in Portland cement. From the top of each shaft to a depth of about 45 feet there is a ½-inch wrought-iron shell outside the brick masonry. The shafts are 62 feet in depth and 139½ feet from centre to centre. The leakage into the tunnel after the work was finished averaged about half a gallon per minute.

The total cost of the work, including the reconstruction of the wooden boxing at each end and repairing fender guard, but not including the cost of laying the pipes, was $21,850.69.

Considerable time and labor have been devoted to making changes in the 24-inch pipe line in Adams Street in Milton and Quincy, made necessary by the work of constructing the Metropolitan sewer in the street. In March a temporary 12-inch line, 250 feet long, was laid around a tunnel shaft near Washington Street, and 180 feet of the 24-inch pipe temporarily abandoned. On August 1 and 2 the connections at the junction of Adams and Beale streets were relocated. In September about 260 feet of 16-inch and 20-inch pipe were laid for temporary use during the construction of the sewer, 150 feet of 24-inch pipe taken up, and 316 feet of 24-inch pipe moved laterally from 1 to 8 feet in order to make room for the sewer trench. On November 27 the location of the pipe was changed for a distance of 125 feet near the corner of Church Street. Watchmen were kept on the ground for several weeks, and the main was shut off a number of times on account of the caving of the sewer trench.

Between May 20 and June 20, 116 feet of 12-inch pipe were raised and 1,377 feet were relaid on Bennington Street in East

Boston, to conform with the revised line and grade where the street had been filled during the previous year.

The ironwork of the bridges supporting the pipes over the Boston & Maine Railroad at Walnut Street and College Avenue in Somerville, the Fitchburg Railroad at Massachusetts Avenue in Cambridge, and the Boston & Albany Railroad at St. James Street in Newton, has been thoroughly cleaned and painted.

For the purpose of recording the pressure in the pipes at different parts of the Metropolitan District, additional Jones recording pressure gages have been established at the gate-house of the Mystic Reservoir and at the offices of the Medford and Quincy water departments. The gage formerly located in the office at No. 3 Mt. Vernon Street has been placed in the fire engine house on Bulfinch Street. At present, 17 of these gages are in use and the records are filed at this office.

Electrolysis.

The investigations relating to injury to the water pipes in the Metropolitan Water District caused by electrolytic action have been continued during the year. The pipes have been examined at several points to determine the extent of the injury being done, and 27 gaging stations have been established and measurements made of the amount of electricity flowing on pipes. The results of the studies and investigations made during the past five years have already been submitted to the Board in a special report.

Clinton Sewerage.

The works have been in daily operation during the whole year. The amount of sewage pumped and filtered has been fully one-third more than during the previous year, the increase being due partly to the greater amount of the ground water caused by greater rainfall, and partly to the construction of a very leaky piece of 12-inch vitrified pipe sewer by the town of Clinton, which was connected with the sewerage system early in September, and, at the request of the Board, cut off on November 30, 1901, pending reconstruction. There was a flow of water from this sewer of about 200,000 gallons per day before any house connection had been made.

The regular force has been one engineer at the pumping station and two attendants at the filter-beds, one of the latter assisting the engineer for a short time each morning. When additional help is required, the force employed on the Wachusett Aqueduct is transferred temporarily.

During the evening of March 23 there was a fire at the pumping station, caused probably by spontaneous combustion, which burned a partition and scorched the ceiling of the engine room, but did no harm to the pumping machinery.

Following are statistics relating to the operation of this station : —

Daily average quantity of sewage pumped (gallons),	838,000
Daily average quantity of coal consumed (pounds),	1,224
Gallons pumped per pound of coal,	684
Number of days pumping,	365
Cost of pumping : —	
Labor,	$1,159 01
Fuel,	995 64
Repairs and small supplies,	365 84
Total for station,	$2,520 49
Cost per million gallons pumped,	$8 24
Cost per million gallons raised 1 foot high,	18

Filter-beds.

During the warmer part of the year the sewage has been applied in about equal quantity to the 19 beds from which all soil had been removed and to the 6 beds from which the soil was not removed, each being used on the average about once in six days. During the colder part of the year only 19 beds from which the soil had been removed were used, and 5 of these beds were furrowed 3 feet 6 inches apart, for use in very cold weather.

As was the case in 1900, the results obtained in 1901 were better in the last half of the year than in the first, as will be seen by the following results of chemical analyses : —

[Parts per 100,000.]

	January to June, inclusive.	July to December, inclusive.	Whole Year.
Albuminoid ammonia, sewage,	.9250	1.0800	1.0025
Albuminoid ammonia, effluent,	.1027	.0454	.0741
Per cent. removed,	87	96	91
Oxygen consumed, sewage,	10.05	11.40	10.73
Oxygen consumed, effluent,	1.06	.58	.82
Per cent. removed,	87	95	91

The sewage treated during 1901 has been much more dilute than during the previous year, and, while the percentage of organic matter removed has not been quite as large, the effluent has been much better. The nitrification has also been better in 1901, especially during the last half of the year. The nitrification during the second half of the year continues much better than during the first half, as is shown by the following statement of free ammonia and nitrates: —

[Parts per 100,000.]

	January to June, inclusive.	July to December, inclusive.
Free ammonia, sewage,	3.0400	3.8667
Free ammonia, effluent,	.9058	.2525
Per cent. removed,	70	93
Nitrogen as nitrates, effluent,	.5383	1.3213

The cost of maintaining the filter-beds has been as follows: —

Labor,	$2,431 51
Repairs and supplies,	103 34
Total,	$2,534 85
Cost per million gallons filtered,	8 29

Appended to this report are tables of contracts giving the amount of work done and other information, a statement of the cement tests, a long series of tables relating to the maintenance of the Metropolitan Water Works, tables showing the length of main pipes and number of service pipes, meters and fire hydrants in the Metropolitan Water District, and a summary of statistics for 1901.

Respectfully submitted,

FREDERIC P. STEARNS,
Chief Engineer.

BOSTON, December 31, 1901.

REPORT OF ENGINEER OF SEWERAGE WORKS.

To the Metropolitan Water and Sewerage Board.

GENTLEMEN : — The following is a report of the operations of the Engineering Department of the Metropolitan Sewerage Works for the fifteen months' period ending December 31, 1901.

ORGANIZATION.

The engineering organization is as follows : —

Division Engineers : —	
FREDERICK D. SMITH, .	In charge of maintenance, South Metropolitan System, and construction of high-level sewer, sections 51 to 63, inclusive, in Quincy and Milton.
C. BARTON PRATT, . .	In charge of construction, high-level sewer, north of Neponset River.
FRANCIS L. SELLEW, .	In charge of construction, high-level sewer, sections 47 to 50, inclusive, in Quincy.
FRANK I. CAPEN, . .	In charge of maintenance and of day-work and contract construction, North Metropolitan System.
FRANK T. DANIELS, .	In charge of draughting rooms.
Assistant Engineers : —	
FRANK A. EMERY, . .	Office assistant in charge of records.
JOHN S. HODGSON, .	In charge of special studies.
Stenographer : —	
HENRY P. FIELDING, .	In charge of classification of engineering reports, claims and correspondence.

In addition to the above, there are employed at this date 87 engineering and other assistants.

METROPOLITAN SEWERAGE DISTRICTS.

Areas and Development.

In the period covered by this report, no legislative enactments have modified the extent or classification of areas comprising the Metropolitan sewerage districts. The North district, lying wholly north of the Charles River, has an area of 85 square miles; the South district, comprising cities and towns south of the Charles River, with Watertown and Waltham on the north, has an area of 102 square miles; making a total, inclusive of water surfaces, of 187 square miles for the two Metropolitan sewerage districts, as outlined on the general map accompanying this report.

The development of this area from the original district created by chapter 439 of the Acts of 1889 is briefly summarized in the following table: —

Table showing the Development of the Metropolitan Sewerage System, 1889 to 1901, inclusive, with the Legislative Acts referring thereto.

	CITIES AND TOWNS INCLUDED IN AREA.	Area provided for (Square Miles).		Number and Date of Act.
North Metropolitan District.	Original North Metropolitan District, including Arlington, Belmont, Boston (portions of), Cambridge, Chelsea, Everett, Malden, Medford, Melrose, Somerville, Stoneham, Winchester, Winthrop and Woburn.	71.88		Chapter 439, Acts of 1889.
	Wakefield (Greenwood and Boyntonville), . .	.95		Chapter 414, Acts of 1896.
	Lexington (part of), ...	5.11		Chapter 520, Acts of 1897.
	Wakefield (central village, etc.), ...	6.70		Chapter 172, Acts of 1900.
	Total area of North Metropolitan District, . .	——	84.64	
South Metropolitan District.	Original Charles River District, including Boston (portions of), Brookline, Newton, Waltham and Watertown.	42.00		Chapter 439, Acts of 1889.
	Neponset valley district, including Boston (portions of), Dedham (part of), Hyde Park and Milton.	39.57		Chapter 406, Acts of 1895.
	High-level sewer: Boston (portions of) and Quincy,	20.98		Chapter 424, Acts of 1899.
	Total area of South Metropolitan District, . .	——	102.55	
	Total area of Metropolitan Sewerage District, December 31, 1901, ...		187.19	

AREAS AND POPULATIONS.

The areas and populations of the cities and towns comprising the Metropolitan Sewerage District are set forth in the following table, in which the populations are approximated from the United States decennial census of 1900: —

Table showing Areas and Estimated Populations within the Metropolitan Sewerage District, as of May 1, 1901.

	CITY OR TOWN.	Area (Square Miles).		Estimated Population.	
North Metropolitan District.	Arlington,	5.20		9,400	
	Belmont,	4.66		4,500	
	Boston (portions of),	3.45		88,900	
	Cambridge,	6.11		96,500	
	Chelsea,	2.24		35,300	
	Everett,	3.34		26,700	
	Lexington,*	5.11		2,800	
	Malden,	5.07		35,800	
	Medford,	8.35		20,100	
	Melrose,	3.78		13,600	
	Somerville,	3.96		65,600	
	Stoneham,	5.50		6,300	
	Wakefield,	7.65		9,900	
	Winchester,	5.95		7,800	
	Winthrop,	1.61		6,900	
	Woburn,	12.71		14,700	
			84.64		444,800
South Metropolitan District.	Boston (portions of),	20.92		133,100	
	Brookline,	6.81		21,800	
	Dedham,*	9.40		7,100	
	Hyde Park,	4.57		13,900	
	Milton,	12.59		7,100	
	Newton,	18.03		36,300	
	Quincy,	12.56		25,800	
	Waltham,	13.63		24,900	
	Watertown,	4.04		10,500	
			102.55		280,500
	Totals,		187.19		725,300

* Part of town.

METROPOLITAN SEWERS.

SEWERS PURCHASED.

Within the Metropolitan Sewerage District there are now 82.47 miles of Metropolitan sewers, as shown on the general map. Of this total, 8.79 miles of sewer and one pumping station located in the city of Quincy have been purchased from cities and towns of the District, as detailed in the following table: —

Table of Sewers and Appurtenances purchased to December 31, 1901.

DATE OF PURCHASE.	From whom purchased.	Size.	Length (Miles).		Cost.	Legislative Acts authorizing Purchase.
September 10, 1892,	City of Boston,	6′ 6″ diameter, 4′ 8″ twin sewer, 5′ 6″ diameter,	.332 .015 .008	.355	$59,076 00	Chapter 439, Acts of 1889, Huntington Avenue sewer.
October 3, 1893,	City of Boston,	26″ × 28″, 15″,	2.240 .547	2.787	52,637 00	Chapter 439, Acts of 1889, Mystic valley sewer.
January 22, 1896,	City of Boston,	36″ × 48″, 28″ × 42″,	.981 .260	1.241	100,000 00	Chapter 406, Acts of 1895, Neponset valley sewer.
November 21, 1896,	Town of Melrose,	24″, 20″, 18″, 15″,	.154 .005 .512 .065	.736	15,000 00	Chapter 414, Acts of 1896, South Wakefield extension.
December 31, 1898,	Town of Arlington,	18″, 15″, 12″,	.999 .115 1.517	2.631	42,400 13	Chapter 520, Acts of 1897, Lexington extension.
October 8, 1898,	City of Malden,	36″, 30″, 18″,	.601 .181 .206	.988	50,096 51	Chapter 215, Acts of 1898, Everett outlet sewers.
August 6, 1900,	Town of Watertown,	24″, 12″,	.002 .049	.051	10,912 00	Chapter 464, Acts of 1900, Watertown siphon.
April 1, 1901,	City of Quincy,	Pumping station,		-	97,384 46	Chapter 424, Acts of 1899, high-level sewer.
Total,				8.789	$428,106 10	

SEWERS CONSTRUCTED AND THEIR CONNECTIONS.

The remaining 73.68 miles of Metropolitan sewer have been constructed by Metropolitan boards.

The position, lengths and sizes of these sewers are given in the following tables, which also give the public and special connections made with the system, in each city and town, under the authority of Metropolitan boards: —

North Metropolitan System.

CITY OR TOWN.	Size of Sewers.	Length in Miles.	Public Connections, December 31, 1901.	SPECIAL CONNECTIONS. Character or Location of Connection.	SPECIAL CONNECTIONS. Number in Operation.
Boston: —					
Deer Island, .	6' 3" to 9', ...	1.367	2	- -	-
East Boston, .	9' to 1', ...	5.467	16	- -	-
Charlestown, .	6' 7"×7' 5" to 1', . .	3.292	11	Navy Yard, ... Almshouse, ...	5
Winthrop, . .	9', ...	2.864	6	Club house, ...	1
Chelsea, . .	8' 4"×9' 2" to 1' 10"×2' 4",	3.787	5	Bakery, ... Rendering works, . . Metropolitan Water Works blow-off.	3
Everett, . .	8' 2"×8' 10" to 4' 8"×5' 1",	2.925	4	Metropolitan Water Works blow-off.	1
Malden, . .	3' 9"×4' 1" to 1' 3", . .	3.931*	28	Metropolitan Water Works blow-off. Private houses, . . .	1 95
Melrose, . .	1' 10"×2' 9" to 10", . .	6.099†	23	Private houses, . . .	93
Cambridge, .	5' 2"×5' 9" to 1' 3", . .	5.968	19	Slaughter house, . . City Hospital, . .	2
Somerville, . .	6' 5"×7' 2" to 1' 10"×2' 3",	3.471	9	Slaughter houses (3), . .	1
Medford, . .	4' 8"×5' 1" to 10", . .	5.359	17	Private houses, . . .	6
Winchester, .	2' 11"×3' 3" to 1' 3", . .	6.408	10	Tannery, ... Private house, . . .	2 1
Stoneham, . .	1' 3" to 10", . . .	.010	3	- -	-
Woburn, . .	1' 10"×2' 4" to 1' 3", . .	.933	3	Glue factory, . . .	1
Arlington, . .	1' 6" to 10", . . .	3.520‡	30	Private houses, . . .	71
Belmont,§ . .	- -	-	1	- -	-
Wakefield,§ .	- -	-	-	- -	-
		55.391‖	187		283

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* Includes .988 of a mile of sewer purchased from the city of Malden.

† Includes .786 of a mile of sewer purchased from the town of Melrose.

‡ Includes 2.631 miles of sewer purchased from the town of Arlington.

§ The Metropolitan sewer extends but a few feet into the towns of Belmont and Wakefield.

‖ Includes 2.787 miles of Mystic valley sewer in Medford, Winchester and Woburn, running parallel with the Metropolitan sewer.

South Metropolitan System.

CITY OR TOWN.	Size of Sewers.	Length in Miles.	Public Connections, December 31, 1901.	Special Connections.	
				Character or Location of Connection.	Number in Operation.
Boston (Back Bay).	6' 6" to 5' 6",	1.500*	8	Private house, Administration building, Boston Park Department,	1 1
Boston (Brighton).	5' 6" to 12",	3.714†	10	Abattoir,	3
Boston (Dorchester).	3'×4' to 2' 6"×2' 7",	2.870‡	6	- -	-
Boston (Roxbury).	6' 6"×7', 2' 0",	.575	-	- -	-
Boston (West Roxbury).	9' 3"×10' 2" to 12",	6.014	3	Parental school,	1
Brookline,	5' 6",	.127	1	- -	-
Dedham,	4'×4' 1" to 3' 9"×3' 10",	2.350	-	- -	-
Hyde Park,	10' 7"×11' 7" to 4'×4' 1",	4.382	10	- -	1
Milton,	11'×12' to 8",	1.189	3	- -	-
Newton,	4' 2"×4' 9" to 1' 3",	2.227	6	Private houses,	2
Quincy,	11' 3"×12' 6" to 11'×12',	1.378	-	- -	-
Waltham,	3' 6"×4',	.001	1	- -	-
Watertown,	4' 2"×4' 9" to 12",	.750§	5	Factory,	2
		27.077	53		11

* Includes .355 of a mile of sewer purchased from the city of Boston.
† Includes .026 of a mile of sewer purchased from the town of Watertown.
‡ Includes 1.24 miles of sewer purchased from the city of Boston.
§ Includes .025 of a mile of sewer purchased from the town of Watertown.

COST OF CONSTRUCTION.

The cost of the 82.47 miles of Metropolitan sewers enumerated above, including five pumping stations, siphons and appertaining structures, may be summarized as follows: *—

North Metropolitan System,	$5,565,707 81
South Metropolitan System,	3,430,229 01
	$8,995,936 82

CONSTRUCTION AND ADDITIONS SINCE SEPTEMBER 30, 1900.

The report of September 29, 1900, indicated that 71.9 miles of Metropolitan sewers had been constructed at that date. There has consequently been added, during the fifteen months under review, a length of 10.57 miles. This includes 3.04 miles in the Wakefield extension, authorized by chapter 172 of the Acts of 1900, and 1.58 miles in additional outlets for the cities of Chelsea and Everett, by chapter 184 of the same year, all in the North Metropolitan District.

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* For detailed statement of cost, see report of Board, p. 53.

In the South Metropolitan District, chapter 204 of the Acts of 1901 authorized an extension of 1.27 miles, to provide additional sewerage facilities for the city of Newton and the town of Brookline in the Neponset valley system. Of this length 0.4 mile have been constructed to date. On April 1, 1901, the pumping station of the Quincy sewerage system was purchased from that city by your Board, under the provisions of the high-level sewer act, and has since that date been operated as part of the South Metropolitan System.

The remaining length of Metropolitan sewers added during the year consists of 5.55 miles of new high-level sewer in the South Metropolitan District, authorized by chapter 424 of the Acts of 1899, and referred to in detail later in this report.

The following table gives details of areas, populations, local sewer mileage and other data for the whole Metropolitan Sewerage System: —

North Metropolitan System.

Area (Square Miles).	Estimated Total Population.	Miles of Local Sewer connected.	Estimated Population contributing Sewage.	Ratio of Contributing Population to Total Population (Per Cent.).	CONNECTIONS MADE WITH METROPOLITAN SEWERS.	
					Public.	Special.
84.64	444,900	485.81	324,333	72.9	187	283

South Metropolitan System.

102.55	280,500	344.24	110,121	39.3	53	11

Entire Metropolitan District.

187.19	725,400	830.05	434,454	59.9	240	294

Contrasting these figures with corresponding data for September 29, 1900, there is an estimated increase in population of 27,400 during the fifteen months under review. Of the estimated gross population of 725,300 on May 1, 1901, 434,454, representing 59.9 per cent., were on that date contributing sewage to the Metropolitan sewers, through a total length of 830.05 miles of local sewers owned by the individual municipalities. These sewers are connected with the Metropolitan System by 240 public and 294 special connections.

Further examination of the figures for this period of fifteen months indicates that the population contributing sewage has probably increased by 27,720; that an addition of 62.54 miles of local sewers has been made to the lengths previously connected, and that 8 public and 34 special connections have been added.

PUMPING STATIONS AND PUMPAGE.

The following table shows the average daily volume of sewage lifted at each of the five Metropolitan pumping stations during the fifteen months' period, as compared with the corresponding volumes for the previous year: —

PUMPING STATION.	AVERAGE DAILY PUMPAGE.			
	Year ending Sept. 30, 1900.	Oct. 1, 1900, to Dec. 31, 1901.	Increase during Period.	
	Gallons.	Gallons.	Gallons.	Per Cent.
Deer Island, ...	44,600,000	52,000,000	7,400,000	16.60
East Boston, ...	42,400,000	49,200,000	6,800,000	16.04
Charlestown, ...	27,500,000	30,700,000	3,200,000	11.64
Alewife Brook, ...	3,543,000	3,780,000	237,000	6.69
Quincy, ...	-	2,014,000	-	-

HIGH-LEVEL SEWER.

Surveys and general studies in connection with the high-level sewer have been continued during the period under review. Of the final location along the whole length, something over 16 miles, from the connection with the existing Charles River system at the intersection of Ruggles and Vancouver streets, near the Fenway, in the Back Bay district of the city of Boston, to the outlet in the harbor, within the limits of the town of Hull, about 1 mile north of Nut Island, has been completed. For convenience, this length has been divided into 36 contract sections. Of these, 4 have been completed and 23 are now in process of construction; contracts for the remaining 9 sections, representing 2.7 miles, are yet to be entered into. The engineering studies for these sections are in condition for the letting of contracts during the coming season.

CONSTRUCTION ON THE NORTH METROPOLITAN SYSTEM (OCTOBER 1, 1900, TO DECEMBER 31, 1901).

ADDITIONS TO PUMPING PLANT, ALEWIFE BROOK STATION.

Chapter 424 of the Acts of 1898 provided for additional engines and pumps at the stations of the North Metropolitan System. At Deer Island, East Boston and Charlestown the plants were installed and accepted prior to the date of the last engineering report. At the Alewife Brook station the George F. Blake Manufacturing Company, contractors for this work, have made various modifications in the plant, with the result of increasing its efficiency, but the full duty guaranteed has not yet been attained.

SEWER CONSTRUCTION IN CHELSEA AND EVERETT, AND EXTENSION TO WAKEFIELD.

The sewer construction on the North Metropolitan System consists of additional outlets for areas in Chelsea and Everett and the extension to Wakefield, respectively authorized by chapters 184 and 172 of the Acts of 1900. The total appropriation made by these acts was $265,000.

The total length of 4.6 miles included in this work was divided, for convenience, into 5 contract sections. The whole of these have been completed. Details of the work are given in a condensed form in the following table, and at greater length in the succeeding description: —

Contract Sections in Chelsea, Malden and Melrose, and Day Work connected therewith, forming Parts of the North Metropolitan Syst
October 1, 1900, to December 31, 1901.

Number of Contract Section.	LOCATION.	Size of Sewer.	Length (Feet).	Total Length of Section (Feet).	Date of Contract.	Date of Completion.	Cost of Work.	Total Cost of Section.	Contractor.
56	Chelsea, — Willoughby Street to Clark Avenue,	42", 33", .	2,812	-	Sept. 17, 1900,	July 1, 1901,	$38,364 17	-	H. A. Hanscom & Co., ton, Mass.
	Day work (connection of Section 56 with existing Metropolitan sewer near Willoughby Street), ...	. . . .	75	- 2,887	-	June 29, 1901,	3,652 69	- $42,016 86	- -
57	Chelsea, — Clark Avenue to Everett line, .	33", 30" and 22"×28", .	-	5,428	Sept. 17, 1900,	Sept. 7, 1901,	-	28,637 85	H. A. Hanscom & Co., ton, Mass.
58	Malden and Melrose, — Barrett's Pond to Goodyear Avenue, ...	48", 54"×58",	5,379	-	Nov. 12, 1900,	Nov. 2, 1901,	59,309 90	-	Bruno, Salamone & Pet Boston, Mass.
	Day work (connection of Section 58 with existing Metropolitan sewer near Barrett's Pond),	. . . .	15	- 5,394	-	Aug. 5, 1901,	910 10	- 60,220 00	- -
59	Melrose, — Goodyear Avenue to near Willow Street, ...	54"×58", 36",	4,779	-	Nov. 12, 1900,	Oct. 16, 1901,	56,500 02	-	Chas. G. Belden & Syracuse, N. Y.
	Day work (part of section near Wyoming Avenue), ...	. . . .	200	- 4,979	-	Oct. 28, 1901,	7,261 90	- 63,761 92	- -
60	Melrose, — between Willow Street and Wakefield line, first contract, ...	36", . .	1,186	-	Nov. 12, 1900,	May 18, 1901,	12,204 67	-	Old Colony Construc Company, Boston, M
	Day work (unfinished portion of first contract),	. . . .	170	-	-	-	4,276 71	-	- - -
	Second contract, remainder of section, . .	36" and 30", .	4,339	- 5,695	June 29, 1901,	Dec. 3, 1901,	47,303 54	- 63,784 92	Metropolitan Contrac Company, Boston, M
	Totals, ...	. . . .	. . .	24,383				$258,421 55	

ADDITIONAL OUTLETS, IN CHELSEA AND EVERETT.

Section 56, Chelsea.

Location. — From near the junction of Eastern Avenue and Willoughby Street, extending northerly through Eastern Avenue and Cabot Street to near the westerly line of Clark Avenue.

Division Engineer in Charge. — Frank I. Capen.

Contractor. — H. A. Hanscom & Co. of Boston.

Length (Feet).	Size.	Average Cut (Feet).	Maximum Cut (Feet).
2,645	42-inch circular, ...	16.70	24.8
242	33-inch circular, ...	19.50	23.3
2,887			

Total cost, ... $42,016.86

Excavation was begun September 25, 1900. The average rate of progress was 72 feet per week, with a maximum of 181 feet. The work was completed July 1, 1901. The work was generally in open trench. A length of 90 feet, under Broadway, was in tunnel. About 1,800 feet at the lower end, built on a pile foundation, was in fine silt, overlaid with from 4 to 6 feet of fibrous peat below filling and road surfacing. Only a small amount of water was found in the trenches. The excavation in the remainder of the section was in clay and hard-pan.

This contract section was connected with the existing Metropolitan sewer by 75 feet of sewer carried under the existing city sewer in Willoughby Street. Two parallel lengths of 20-inch cast-iron pipe were used for the sewer crossing. The whole length is on a pile foundation, and was constructed by day labor, at a total cost of $3,652.69.

Section 57, Chelsea.

Location. — From near the westerly line of Clark Avenue, westerly through private land and the Metropolitan Park Reservation to Garfield Avenue; thence through Bell Street and Springvale Avenue to the boundary line between Chelsea and Everett.

Division Engineer in Charge. — Frank I. Capen.

Contractor. — H. A. Hanscom & Co. of Boston.

Length (Feet).	Size.	Average Cut (Feet).	Maximum Cut (Feet).
1,653	33-inch circular, ...	8.00	8.00
651	30-inch circular, ...	7.00	7.00
3,122	22-inch by 28-inch Gothic, ...	11.75	23.20
5,426			

Total cost, ... $28,637.85

progress was 111 feet per week, with a maximum of 322 feet. The work was completed September 7, 1901. The excavation was wholly in open trench, and for a length of 2,900 feet from Clark Avenue, passing through the marshes near Mill Creek, was in hard blue clay, overlaid with from 2 to 4 feet of peat. The remainder of the section was in hard-pan, sand and gravel. But little water was found in the trenches, except for about 200 feet adjoining the Everett line, where the flow from springs required the use of a pulsometer pump.

EXTENSION TO WAKEFIELD.

Section 58, Malden and Melrose.

Location. — **From junction with existing Metropolitan sewer in private land, near Barrett's Pond, in Malden, northerly through private land, Linden Avenue, Clinton Street and land of the Boston & Maine Railroad to near the southerly side of Goodyear Avenue, in Melrose.**

Division Engineer in Charge. — **Frank I. Capen.**

Contractor. — **Bruno, Salomone & Pettiti of Boston.**

Length (Feet).	Size.	Average Cut (Feet).	Maximum Cut (Feet).
2,665	48-inch circular, ...	16.2	23.0
2,729	54-inch by 58-inch oval, ...	9.6	13.0
5,394			

Total cost, ... $60,220.00

Excavation was begun on December 11, 1900. The entire section was completed on November 2, 1901. The average rate of progress of excavation was 120 feet per week, with a maximum of 287 feet.

A bell-mouth structure was built at Linden Avenue, near station 2+00, to provide for a southerly extension of the sewer at a future date.

The 48-inch sewer was carried over the existing Metropolitan sewer, near Oak Grove station, by 24 feet of 48-inch cast-iron pipe. Above this crossing the sewer is 54 inches by 58 inches in diameter. At the crossing of Spot Pond Brook, near Fells station, 42-inch cast-iron pipes are used.

Near the lower end the excavation was in gravel, boulders and rock; the remainder was in fine sand.

Surplus earth from the trench was used to form an embankment over the sewer in the Boston & Maine Railroad land, and for filling land adjacent to other parts of the work.

This contract section was connected with the existing Metropolitan sewer by 15 feet of sewer, consisting of bell-mouth structure and entrance man-hole, near Barrett's Pond. This work was constructed by day labor, at a total cost of $910.10.

Section 59, Melrose.

Location. — **From near the southerly side of Goodyear Avenue, northerly through location of Boston & Maine Railroad to Foster Street; thence through private land to a point in Essex Street, about 170 feet west of Willow Street.**

Division Engineer in Charge. — **Frank I. Capen.**

Contractor. — **Charles G. Belden & Co. of Syracuse, N. Y.**

Length (Feet).	Size.	Average Cut (Feet).	Maximum Cut (Feet).
3,200	54-inch by 58-inch oval, ...	11.9	16.5
1,779	36-inch circular, ...	15.9	18.0
4,979			

Total cost, ... $63,761.92

Excavation was begun on December 3, 1900, and the contract work was completed on October 16, 1901. The average progress of earth excavation was 112 feet per week, with a maximum of 315 feet.

The excavation was generally in fine sand, with occasional lengths of gravel and clay and a small amount of rock.

Surplus material from the trench was used by the Boston & Maine Railroad for grading along its right of way.

Near Wyoming station the sewer passes under the existing Metropolitan sewer and the Ell Pond Brook culvert, and is also close to the foundations of a business block. A length of 200 feet was omitted in the contract section at this point, and this portion of the work was completed later by day labor, at a total cost of $7,261.90. It consists principally of brick sewer, with connection chambers at the junction with the original Metropolitan sewer. Twenty-four feet of 54-inch cast-iron pipe, reinforced with concrete, were used in passing the Ell Pond Brook culvert.

Section 60, Melrose.

Location. — **From a point in Essex Street, about 170 feet west of Willow Street, northerly through Essex, Tremont and Franklin streets, Winthrop Place and location of Boston & Maine Railroad to the Wakefield line.**

Division Engineer in Charge. — **Frank I. Capen.**

Contractor. — **The Old Colony Construction Company, succeeded by the Metropolitan Contracting Company, both of Boston.**

Length (Feet).	Size.	Average Cut (Feet).	Maximum Cut (Feet).
2,781	36-inch circular, ...	15.0	22.0
2,914	30-inch circular, ...	14.5	19.5
5,695			

Total cost, ... $63,784.92

Of the total length, 1,425 feet of 36-inch and 2,914 feet of 30-inch sewer were built by the Metropolitan Contracting Company.

Excavation was begun by the Old Colony Construction Company on November 28, 1900, and continued until May 18, 1901, when the contract was abandoned, leaving considerable trench ready for the structures. The masonry work in these lengths of trench was built by day labor, under the direct supervision of the Engineer. Including these lengths, the work accomplished under the original contract amounted to 1,356 feet of 36-inch sewer. Bids were obtained for constructing the remainder of the section, and June 29, 1901, a contract for this work was entered into by the Metropolitan Contracting Company. Work was commenced on July 8 and advanced rapidly until its completion on December 3, 1901.

The average rate of progress under the original contract was 54 feet per week, for two openings; the average under the second contract was 206 feet per week, with three openings.

Much of the excavation was in sand and gravel, yielding considerable quantities of water and requiring heavy sheeting in the trenches. The maximum rate of pumpage was 1,000,000 gallons per twenty-four hours. For a length of 700 feet, in Tremont Street, passing the end of Ell Pond, the sewer was built on a pile foundation; in two lengths of 300 and 350 feet, respectively, the bottom of the trench was in rock.

The day work included the refilling of 240 feet of sewer trench abandoned by the Old Colony Construction Company, the completion and refilling of 150 feet of partly excavated trench, the building of 170 feet of brick sewer, and the subsequent resurfacing of streets. The total cost of work done by day labor was $4,276.71.

This section terminates at the Wakefield line, and provides for the connection at that point of the system of sewers now being constructed by that town.

CONSTRUCTION ON THE SOUTH METROPOLITAN SYSTEM (OCTOBER 1, 1900, TO DECEMBER 31, 1901).

This construction consists of the Neponset valley sewer extension, authorized by chapter 254 of the Acts of 1901, and of the high-level sewer by chapter 424 of the Acts of 1899, which has been under construction since November of that year.

NEPONSET VALLEY SEWER, WEST ROXBURY AND NEWTON.

Section 30.

Division Engineer in Charge. — C. Barton Pratt.
Contractor. — Thomas J. Kelley, Brookline, Mass.

This contract embraces the construction of brick and pipe sewers extending from the existing Neponset Valley sewer, in St. Joseph's Cemetery, West Roxbury, through the cemetery and other private lands in West Roxbury and Newton, to the Brookline town line, midway between Newton and La Grange streets, — a total distance of 6,718 feet. Of this length, 2,356 feet is to be 24-inch brick sewer, and the remainder 18-inch and 15-inch pipe sewers. The route follows generally the brook valleys, and the excavation is in sand, gravel and sandy clay, with an average depth of 9 feet. A small amount of rock has been found in the excavation. During winter storms the trenches through the valleys have been flooded and the work has been delayed by this cause. About 1,800 feet of sewer has been constructed to date.

QUINCY PUMPING STATION.

On April 1, 1901, the sewage pumping station of the city of Quincy was purchased by the Commonwealth, as contemplated by the high-level sewer act. The pumping station and plant consist of a one-story brick building, 85 by 45 feet, with a heavy slated roof, erected in 1897–98; two Deane pumps, with boilers and all other necessary appurtenances, having a capacity of 3,000,000 and 5,000,000 gallons per day, respectively; and about 2¾ acres of land, — the whole located near the northerly limit of the city park known as Merrymount Park. The purchase includes a 24-inch cast-iron force main from the pumping station to its junction with the outfall sewer of the Boston main drainage system, at Squantum, a distance of about 3.4 miles, together with all rights and easements in relation thereto acquired by the city of Quincy. The price paid for the works was $97,984.46.

The pumping plant has been operated by this department, as part of the South Metropolitan Sewerage System, since April 1, 1901. The sewage is still pumped into the Boston main drainage system, at Squantum, but on the completion of the high-level sewer it will be pumped into that structure, in Greenleaf Street, through a new force main, when the connection with the Boston works will be abandoned.

HIGH-LEVEL SEWER CONSTRUCTION.

Route of High-level Sewer.

Prior to September 29, 1900, construction on the high-level sewer had been confined to that portion, about 6½ miles in length, located north of the Neponset River. The route of the sewer, extending from the proposed pumping station in Ward Street, Roxbury, to the Neponset River, was fully described in the twelfth annual report of the Metropolitan Sewerage Commissioners. The sewer will be carried under the Neponset River by three parallel lines of 60-inch cast-iron pipe, connected on each bank with the ordinary sewer structures by masonry pipe chambers, arranged for controlling or diverting the flow through the individual pipe lines.

South of the Neponset River, the sewer, 10 feet 7 inches by 11 feet 7 inches in diameter, will pass through private land and across Brush Hill Road and Blue Hill Avenue to Brook Road, in Milton. It will follow Brook Road, partly in open cut and partly in tunnel, to and under Pine Tree Brook. From this point, across Central Avenue to Adams Street, in Milton, a distance of about 11,400 feet, the route will be along the lines of a boulevard extension as laid out by the town of Milton. The sewer will follow Adams Street in open cut, crossing the New York, New Haven & Hartford Railroad

(Granite Branch), to near Church Street, where its size will be increased to 11 feet by 12 feet. From this point it will pass in rock and earth tunnel along Adams Street and across the Quincy line to Eaton's Pond, on Furnace Brook, where the vertical diameter will be increased to 12 feet 3 inches. It will continue, in a northeasterly direction, along the location of the proposed Metropolitan Furnace Brook Parkway and through private lands on the southerly side of Furnace Brook, to Adams Street, in Quincy. It will extend thence, generally in an easterly direction, through Adams Street, Upland Road and private lands, partly in tunnel, to Hancock Street, where its dimensions will be increased to 11 feet 3 inches by 12 feet 6 inches. It will continue through Greenleaf Street and in private lands near Mount Wollaston Cemetery to Sea Street, which it will traverse for about 2,000 feet before entering Quincy marsh. Its course will then lie in the marsh for a distance of about 9,400 feet, nearly all in embankment, to the junction of Sea and Darrow streets, in Quincy. From this point the line follows Sea and Ratchford streets and private lands to the shore of Quincy Bay. The sewer will be carried, in a short embankment, across an angle of the bay and through private lands to a tunnel in Island Avenue, Hough's Neck, passing under Quincy Great Hill, emerging at the upper end of an embankment which will connect Nut Island with the mainland. On Nut Island there will be special structures for intercepting sand and floating matter before the sewage enters the sea outfalls. The latter will consist of 60-inch cast-iron pipes, laid in dredged trenches in the harbor bed, and carried to points about a mile beyond low-water line of Nut Island.

It is proposed to lay two such lines in the early future, and to make provision for connecting additional lines, as required.

For purposes of construction the high-level sewer has been divided into 36 contract sections, of which 14 are north of and 22 south of the Neponset River. Particulars of these sections are condensed in the following table: —

Details of Contract Sections, High-level Sewer.

Number of Contract Section.	LOCATION.	Size of Sewer.	Total Length of Section (Feet).	Estimated Length in Trench (Feet).	ESTIMATED LENGTH IN TUNNEL.		Date of Contract.	Date named for Completion.	Amount of Contract.	Estimated Value of Work completed to Dec. 31, 1901.	Contractor.
					Earth (Feet).	Rock (Feet).					
43	Quincy and Hull, — harbor outfalls.	Two 60-inch pipes.	5,694*	5,694	-	-	-	-	-	-	- -
44	Quincy, — Nut Island and Hough's Neck.	11' 3"×12' 6",	1,285	1,285	-	-	-	-	-	-	- -
45	Quincy, — Island Avenue, Hough's Neck.	11' 3"×12' 6",	918	-	918	-	-	-	-	-	- -
46	Quincy, — private land and flats.	11' 3"×12' 6",	823	823	-	-	-	-	-	-	- -
47	Quincy, — private land, Ratchford and Sea streets.	11' 3"×12' 6",	3,162	3,162	-	-	Oct. 3, 1901,	Jan. 1, 1903,	$95,796 28	$8,550 00	Chas. G. Belden & Co., Quincy, Mass.
48, 49	Culverts and embankments.	-	-	-	-	-	May 23, 1901,	Feb. 1, 1902,	70,175 00	25,000 00	Chas. G. Belden & Co., Quincy, Mass.
48	Quincy, — private lands, .	11' 3"×12' 6",	5,881	5,881	-	-	-	-	-	-	- -
49	Quincy, — private lands, .	11' 3"×12' 6",	3,494†	3,494	-	-	May 23, 1901,	Feb. 1, 1902,	69,350 00	63,920 00	Chas. G. Belden & Co., Quincy, Mass.
50	Quincy, — Sea Street and private lands.	11' 3"×12' 6",	3,071	3,071	-	-	Oct. 3, 1901,	Dec. 1, 1902,	94,168 80	12,950 00	Chas. G. Belden & Co., Quincy, Mass.
51	Quincy, — Greenleaf Street,	11' 3"×12' 6",	2,366	2,366	-	-	Jan. 19, 1901,	Mar. 1, 1902,	79,695 70	66,100 00	Thos. F. Moore, Syracuse, N. Y.
52	Quincy, — private lands, Upland Road and Adams Street.	11' 0"×12' 3",	2,774	2,567	207	-	Oct. 1, 1901,	Jan. 1, 1903,	167,376 30	11,180 00	National Contracting Company, New York, N. Y.
53	Quincy, — Adams Street, private lands and Furnace Brook Parkway location.	11' 0"×12' 3",	1,990	1,900	-	-	Oct. 1, 1901,	Jan. 1, 1903,	99,502 00	5,180 00	National Contracting Company, New York, N. Y.
54	Quincy, — Furnace Brook Parkway location and Adams Street.	11' 0"×12' 3",	1,990	1,990	-	-	Oct. 1, 1901,	Jan. 1, 1903,	98,936 00	4,580 00	National Contracting Company, New York, N. Y.
55	Quincy and Milton, — Adams Street.	11' 0"×12' 0",	3,555	400	1,555	1,600	Nov. 26, 1900,	June 1, 1902,	239,800 00	104,100 00	H. P. Nawn, Boston, Mass.

* Mean of two lines.

† 2,000 feet of sewer included in contract.

Details of Contract Sections, High-level Sewer — Concluded.

Number of Contract Section.	LOCATION.	Size of Sewer.	Total Length of Section (Feet).	Estimated Length in Trench (Feet).	Estimated Length in Tunnel.		Date of Contract.	Date named for Completion.	Amount of Contract.	Estimated Value of Work completed to Dec. 31, 1901.	Contractor.
					Earth (Feet).	Rock (Feet).					
56	Milton, — Adams Street, .	10' 7"×11' 7",	1,495	1,495	-	-	Nov. 26, 1900,	Nov. 1, 1901,	$86,060 00	$91,100 00	National Contracting Company, New York, N. Y.
57	Milton, — boulevard location, Adams Street to Pleasant Street.	10' 7"×11' 7",	1,874	1,874	-	-	Oct. 23, 1901,	Jan. 1, 1903,	58,840 00	7,990 00	J. W. Bustin & Co., Syracuse, N. Y.
58	Milton, — boulevard location, Pleasant Street to Centre Street.	10' 7"×11' 7",	2,560	2,560	-	-	Oct. 12, 1901,	Apr. 1, 1903,	81,097 00	900 00	Latta & Terry Company, Philadelphia, Pa.
59	Milton, — boulevard location, Centre Street to Randolph Avenue.	10' 7"×11' 7",	2,567	2,567	-	-	Oct. 8, 1901,	Apr. 1, 1903,	100,116 00	6,100 00	H. P. Nawn, Boston, Mass.
60	Milton, — boulevard location, Randolph Avenue to Canton Avenue.	10' 7"×11' 7",	1,609	1,609	-	-	Oct. 23, 1901,	Jan. 1, 1903,	53,452 50	-	J. W. Bustin & Co, Syracuse, N. Y.
61	Milton, — Brook Road, or boulevard extension.	10' 7"×11' 7",	2,800	2,800	-	-	-	-	-	-	- -
62	Milton, — Brook Road, westerly from Pine Tree Brook.	10' 7"×11' 7",	2,174	1,778	-	396	Nov. 17, 1900,	Nov. 1, 1901,	112,750 00	107,300 00	E. W. Everson & Co., Providence, R. I.
63	Milton, — Brook Road and private land to near Neponset River.	10' 7"×11' 7",	2,262	2,262	-	-	Nov. 26, 1900,	Nov. 1, 1901,	103,875 00	86,500 00	National Contracting Company, New York, N. Y.
64	Milton and Hyde Park, — Neponset River crossing.	Three 60-inch pipes, etc.	272	272	-	-	-	-	-	-	- -
65	Hyde Park, — Monponset, River and Baldwin streets.	10' 7"×11' 7", 9' 3"×10' 2".	900	900	-	-	Oct. 13, 1899,	Apr. 12, 1901,*	38,610 00	34,100 00	Beckwith & Quackenbush, Mohawk, N. Y.
66	Hyde Park, — Baldwin Street, Ruskin Road, private land.	9' 3"×10' 2", .	5,300	-	-	5,300	Oct. 13, 1899,	Oct. 1, 1901,	215,600 00	123,620 00	Ed. W. & John J. Everson, Providence, R. I.

67	Hyde Park, — Stony Brook crossing, private land.	9' 3"×10' 2", two 60-inch pipes.	327	327	-	-	†	-	21,000 00‡	4,000 00	Day labor.
68	Hyde Park and West Roxbury, — private land, Ashland Street, Hadwin Way.	9' 3"×10' 2", 8' 9"×9' 8".	2,738	2,698	40	-	Oct. 13, 1899,	Dec. 8, 1900,*	68,843 00	71,080 00	Beckwith & Quackenbush, Mohawk, N. Y.
69	West Roxbury, — Hyde Park Avenue.	8' 9"×9' 8", .	2,596	2,596	-	-	Oct. 13, 1899,	July 1, 1901,*	86,125 00	92,820 00	Beckwith & Quackenbush, Mohawk, N. Y.
70	West Roxbury, — Larch Place, private land, South Street.	8' 9"×9' 8", .	3,740	3,740	-	-	Apr. 14, 1900,	Dec. 1, 1901,	89,492 00	89,870 00	Chas. Linehan, Cambridge, Mass.
71	West Roxbury, — South Street, private land.	8' 9"×9' 8", .	2,193	2,005	188	-	Apr. 14, 1900,	July 19, 1901,*	70,100 00	84,140 00	Chas. F. Taylor & Co., Syracuse, N. Y.
72	West Roxbury, — South Street.	8' 9"×9' 8", .	3,010	1,870	1,140	-	Sept. 29, 1900,	July 1, 1901,	108,101 00	107,480 00	Jones & Meehan, Boston, Mass.
73	West Roxbury, — South and Centre streets.	9' diameter, .	4,775	-	3,375	1,400	Nov. 3, 1900,	Jan. 1, 1903,	236,425 00	36,550 00	National Contracting Company, New York, N. Y.
74	West Roxbury and Roxbury, — Centre and Day streets.	8' 3"×9' 2", 6' 6"×7' 0"	2,985	200	-	2,785	Sept. 17, 1900,	Oct. 1, 1902,	129,965 00	116,900 00	H. P. Nawn, Boston, Mass.
75	Roxbury, — private land, St. Alphonsus Street.	6' 6"×7' 0", .	3,070	-	-	3,070	Oct. 11, 1901,	Nov. 1, 1902,	117,000 00	81,460 00	Shailer & Schniglan Company, Chicago, Ill. (part of); Ed. W. & John J. Everson, Providence, R. I. (remainder).
76	Roxbury, — St. Alphonsus, Ward, Smith, Oregon, Conant and Phillips streets.	48-inch pipe (force mains).	1,490§	1,490	-	-	-	-	-	-	- -
77	Roxbury, — Ward Street pumping station and connections.	-	420	420	-	-	-	-	-	-	- -
78	Roxbury, — Vancouver Street; pumping station to Charles River sewer.	6' 6"×7' 0", .	700	700	-	-	-	-	-	-	- -
	Totals, ...	. . .	88,770	66,796	7,423	14,551	-	-	$2,782,241 58	$1,393,420 00	

* Date of actual completion.

† Now in course of construction by Engineering Department.

‡ Estimated cost.

§ Mean of two lines.

This table indicates that, out of a total length of 16.81 miles of high-level sewer, 14.08 miles have been contracted for. Of this length, 7.24 miles are excavated to grade in trench or tunnel, leaving 6.84 miles at a less advanced stage of construction and 2.73 miles yet to be advertised. The total value of work already under contract is $2,782,241, of which work valued at $1,393,420, representing 50 per cent., has been constructed to date.

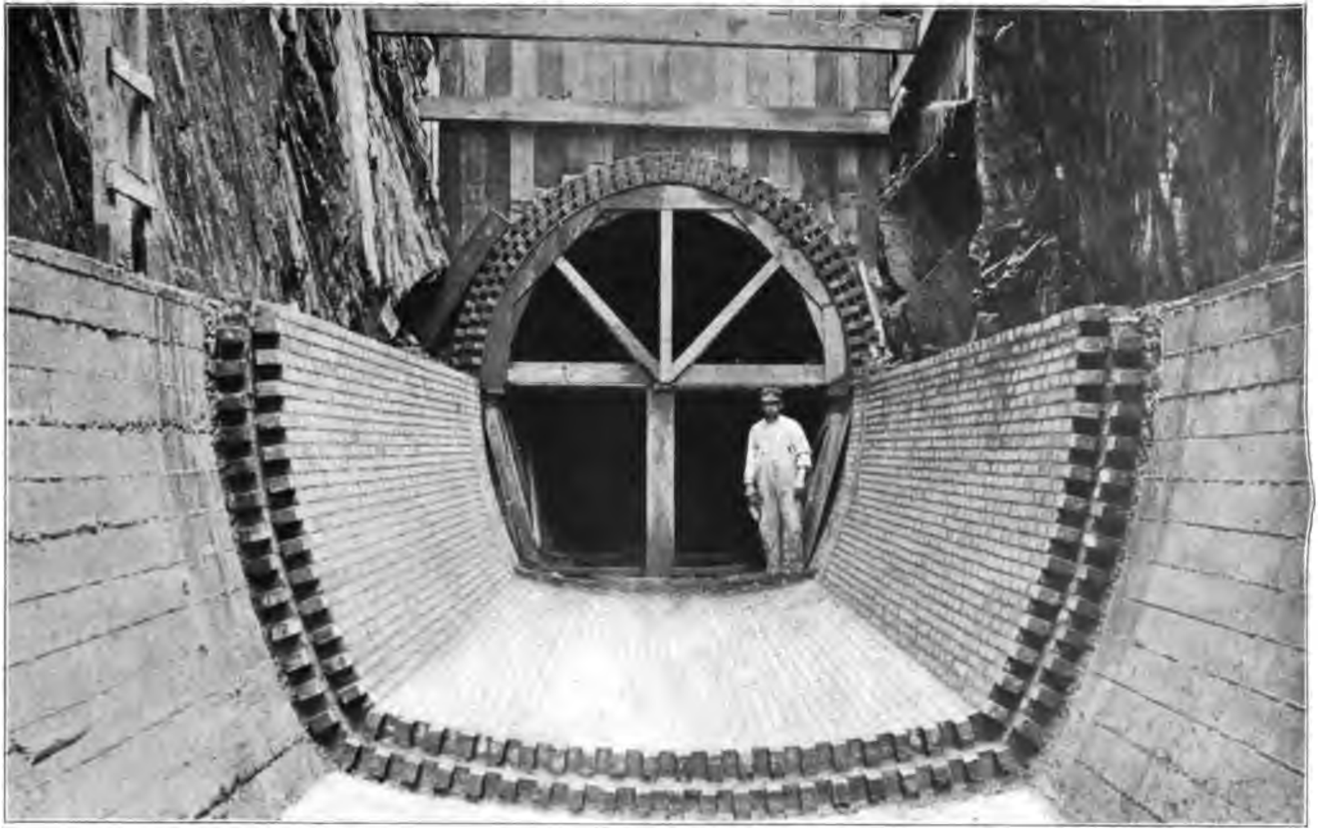
The table shows further that 12.65 miles of the total length of high-level sewer are designed to be constructed in open trench, the remaining 4.16 miles being in tunnel. The latter portion of the work is estimated as consisting of 1.41 miles of earth tunnel and 2.75 miles of rock tunnel.

During the period covered by the present report approximately 75,000 cubic yards of rock have been excavated in tunnel and in open cut. About 90 tons of dynamite or other explosives have been used.

Type of High-level Sewer.

With the exception of Section 73, in which constructional reasons dictated a circular cross-section, the high-level sewer is of the horseshoe type, in which the horizontal diameter closely approximates nine-tenths of the vertical. The arch is slightly pointed. The usual construction consists of concrete invert and side walls, lined with brickwork in cement. Where the work is under any considerable head of ground water, two rings of brickwork, aggregating 8 inches in thickness, are used in the invert and side walls. In dry ground a single ring of brickwork is used. The inner ring is in all cases built in Portland cement mortar. The brick arch is usually 12 inches thick, and is generally built in Rosendale natural cement mortar. In the 6 feet 6 inches by 7 feet sewer above the bell-mouth structure at Perkins Street (sections 74 and 75) the brickwork of the arch is 8 inches thick. In favorable ground Rosendale cement is used for concrete for the outer brickwork ring of the invert and for the arch; but Portland cement is substituted, both for brickwork and concrete, to meet such conditions as the presence of water in the bottom or sides of the trench, for construction in embankment, etc.

The following brief description refers only to sections wholly or partly constructed, or upon which liabilities have been incurred.



HIGH LEVEL SEWER — CONSTRUCTION IN OPEN CUT THROUGH ROCK, IN ADAMS STREET, EAST MILTON.

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Section 43, Quincy and Hull.

This comprises the 60-inch cast-iron outfalls extending from near the shore of Nut Island to points 1 mile beyond low-water line. The pipes will be laid in a trench dredged in the bed of the harbor. Two lines, respectively 5,555 and 5,833 feet long, are contemplated at present. A contract has been entered into with the United States Cast-iron Pipe and Foundry Company for 2,920 tons of 60-inch straight pipe and 70 tons of 60-inch specials required for the longer line. These are to be delivered on Barker's Wharf, Quincy Point, between April 1 and November 1, 1902, so as to be available for placing in the harbor during the coming season.

Section 47, Quincy.

Division Engineer in Charge. — **Francis L. Sellew.**
Contractor. — **Charles G. Belden & Co., Syracuse, N. Y.**

The sewer is 11 feet 3 inches by 12 feet 6 inches in diameter and 3,162 feet in length. It extends from Prospect Avenue, through private land, Ratchford and Sea streets to the intersection of the latter with Darrow Street. The excavation, in dry sand and gravel, has an average depth of about 20 feet. For a length of about 300 feet near Winthrop Street the construction is partly in embankment. At the upper end of the section, near Darrow Street, the grade of Sea Street is to be raised about 4 feet, to afford a sufficient depth of cover over the sewer arch.

Excavation was commenced on Sea Street, near Manet Avenue, on October 31, 1901. To avoid interference with summer travel to Hough's Neck, the construction on Sea Street, east of Manet Avenue, is being carried on during the winter months. About 300 feet of sewer have been completed to date.

Culverts and Embankments, Sections 48–49, Quincy.

Division Engineer in Charge. — **Francis L. Sellew.**
Contractor. — **Charles G. Belden & Co., Syracuse, N. Y.**

Sections 48 and 49 have a total length of 9,375 feet, extending from the intersection of Sea and Darrow streets through private and marsh lands, in a westerly direction, generally parallel to Sea Street, to a point on the upland about 35 feet southeasterly from Sea Street, near the Adams homestead. For a length of 8,200 feet the elevation of the ground is such as to involve the construction of the sewer in embankment. The top of the finished embankments will be 3 feet above the outside of the sewer arch and 19 feet above marsh level; it will be 25 feet in width, and slopes of 2 horizontal to 1 vertical will give a bottom width of 100 feet. Where exposed to wash from floods or tide, the slopes will be protected by stone riprap up to an elevation of 18 feet above mean low water. Above this elevation the slopes will be dressed with loam or vegetable mould from the marsh excavations.

This contract includes the construction of embankments, to subgrade, for the whole length of Section 48, or 5,881 feet, and for about 1,200 feet of Section 49. The remaining length of embankment on Section 49, about 1,000 feet, is included in other contracts.

Important areas of marsh and other lands will be enclosed between the embankment and Sea Street, thus impounding drainage water otherwise flowing to the sea across the sewer location. To provide outlets for this water, masonry culverts are built through the embankments under the location of the sewer structure. These will have cut-stone faces and coursed ashlar inlets and outlets. Culverts on Section 48 are included in this contract, as detailed in the following table: —

Culverts, Section 48.

LOCATION.	Cross-section.	Length (Feet).	Length over All (Feet).	Details of Construction.
Near Malvern Road, Station 9 + 70.	4' 0" circular,	77	94	Concrete, with brick lining; 2 12-foot lengths of cast-iron pipe immediately under sewer structure.
Near Newton Street, Station 17 + 95.	4' 0" circular,	79	97	
Rock Island Road, Station 37 + 65.	9' 6" × 4' 6" (double).	100	110	Concrete, with brick lining; 12-inch steel channel stiffeners over arches, anchored by 1¼-inch steel tie-rods; on pile foundation.

About 70 per cent. of the work on these culverts is completed to date.

The embankments on Section 48 will cut off travel to farm areas formerly reached by Rock Island Road, now built at about marsh level. This road will be diverted over the top of the embankment by sloped approaches. One of the approaches will pass over a diverted tidal creek by means of a pile bridge, already completed.

The sand and gravel filling for the embankments is being obtained from an area of 14 acres of upland, southeast of the intersection of

Palmer and Sea streets, purchased for this purpose by the Commonwealth. The marsh land upon which the embankments are filled is underlaid by strata of mud and peat to a maximum depth of 28 feet. The present contract, involving 180,000 cubic yards of filling, provides for the construction of embankments to sub-grade, about 12 feet above the level of the marsh and 7 feet below the proposed finished grade. This upper 7 feet of embankment fill will be formed of material displaced by the masonry structure of the sewer to be constructed within the embankment at a later date, after the filling has ceased settling into the marsh, and the embankment has reached a condition of equilibrium.

Embankment filling was begun June 20, 1901; 60,000 cubic yards of filling, equal to one-third of the contract volume, have been deposited to date. The average rate of filling has been 400 cubic yards, and the maximum 800 cubic yards, per day. Observations of the settlement of embankments already filled to sub-grade indicate a maximum vertical settlement slightly exceeding 4 feet. This implies that the settling of the embankment into the marsh has displaced about 30 per cent. of the cross-sectional area of mud underlying the actual location.

Section 49, Quincy.

Division Engineer in Charge. — **Francis L. Sellew.**
Contractor. — **Charles G. Belden & Co., Syracuse, N. Y.**

The complete section will extend from a point in the upland, adjacent to Quincy marsh, southeast of Palmer Street, westerly across Palmer Street and through the marsh, in a course generally parallel to Sea Street, to a point on the upland about 35 feet southeasterly from Sea Street, near the Adams homestead, a distance of 3,494 feet. For about one-third of this length the sewer will be constructed, at a later period, in filled embankments, as described under the preceding contract. The work of forming the embankments on 1,200 feet of this length forms part of that contract. The present contract for sewer construction applies to three lengths of 11 feet 3 inches by 12 feet 6 inches sewer, aggregating about 2,000 feet, in dry sand and gravel, at an average depth of 15 feet below the original surface, together with about 1,000 feet of embankment, formed of surplus material from the trenches, and three culverts crossing the location of the embankments. Details of these culverts are given in the following table: —

Culverts, Section 49.

LOCATION.	Cross-section.	Length (Feet).	Length over All (Feet).	Details of Construction.
Near Albatross Road, Station 10 + 65.	4' 0" circular,	74	99	Concrete, with brick lining; 2 12-foot lengths of cast-iron pipe immediately under sewer structure.
Near Curlew Road, Station 21 + 95.	4' 0" circular,	75	99	Concrete, with brick lining.
Near Adams homestead, Station 32 + 65.	2' 6" circular,	91	118	

Excavation was begun June 5, 1901. At the present time, about 1,900 feet of sewer and the whole of the culverts are completed; the filling of the embankments is also completed, but work remains to be done on the slopes.

Section 50, Quincy.

Division Engineer in Charge. — **Francis L. Sellew.**
Contractor. — **Charles G. Belden & Co., Syracuse, N. Y.**

This 11 feet 3 inches by 12 feet 6 inches sewer extends from a point in the upland, about 35 feet southeasterly from Sea Street, near the Adams homestead, westerly through Sea Street and private lands to Greenleaf Street, — a total distance of 3,071 feet. The sewer is nearly all in open cut, with an average depth of 18 feet, in dry sand and gravel. A short length will be constructed in embankment, where it crosses the end of a pond in the Adams home estate, near Mount Wollaston cemetery. A special foundation of boulder concrete is to be used through the pond. Where the sewer enters Sea Street, a modified cross-section is adopted for a length of 220 feet, owing to the low elevation of Sea Street in that vicinity.

Work was commenced on October 28, 1901. About 500 feet of sewer have been completed to date.

Section 51, Quincy.

Division Engineer in Charge. — **Frederick D. Smith.**
Assistant Engineer. — **Seth Peterson.**
Contractor. — **Thomas F. Moore, Syracuse, N. Y.**

The sewer extends northwesterly in Greenleaf Street, from near the Mount Wollaston Cemetery, to Hancock Street, a distance of 2,366 feet. It is 11 feet 3 inches by 12 feet 6 inches in diameter.

The work is in open cut, chiefly in coarse sand and gravel, free from water, at an average depth of 23 feet. The excavation is carried on by an excavating machine, invented and owned by the contractor.

Work was commenced at the lower end of the section in March, 1901. About 2,000 feet of sewer have been completed to date. Passing the end of Woodward Avenue, the invert of the sewer is reinforced by additional concrete, and further stiffened, by steel beams, over the location of a main sewer of the city of Quincy executed in tunnel at a lower elevation than the new sewer. The arch was reinforced with concrete for 250 feet east of Woodward Avenue and for 115 feet east of Valley Street. Two 30-inch branches have been inserted in the westerly side of the sewer, at Park Road and Putnam Street respectively, for the future connection of force mains from the sewage pumping station in Merrymount Park, Quincy. Additional 8-inch branches have been inserted at Park Road, Cedar Place, Putnam Street and Woodward Avenue.

Section 52, Quincy.

Division Engineer in Charge. — Frederick D. Smith.
Assistant Engineer. — Seth Peterson.
Contractor. — National Contracting Company, New York, N. Y.

The sewer begins at the westerly end of Greenleaf Street, at Hancock Street, crosses Hancock and Adams streets, private lands, and the New York, New Haven & Hartford Railroad (Plymouth Division) to Upland Road, and passes thence along Upland Road and Adams Street to beyond Oakland Avenue, a total distance of 2,774 feet. Of this length, about 250 feet, crossing Adams Street and private lands to the railroad, are expected to be in tunnel. The remaining 2,524 feet will be in open cut, in coarse sand and gravel with a large amount of rock, with an average depth of 17 feet above the rock excavation. A very small flow of water has been met with to date. The sewer is 11 feet by 12 feet 3 inches in diameter. Excavation began early in October, 1901, and has been carried on by cable excavating machinery. It has been largely confined, to date, to Adams Street, with the intention of leaving that street clear during the summer months. About 280 feet of trench have been excavated to date. A 10-inch branch has been built into the sewer at Goffe Street.

Section 53, Quincy.

Division Engineer in Charge. — **Frederick D. Smith.**
Assistant Engineer. — **Seth Peterson.**
Contractor. — **National Contracting Company, New York, N. Y.**

The sewer commences in Adams Street, southwest of Oakland Avenue. On leaving Adams Street, it passes westerly through private land and the location of the Furnace Brook Metropolitan Parkway for a distance of 1,900 feet. It is 11 feet by 12 feet 3 inches in diameter. The work will be wholly in open cut, having an average depth of 13 feet of earth excavation in sand and gravel, with a large amount of rock excavation in addition. The excavation is being carried on by cable excavator. Through the parkway location an embankment will be formed over the sewer to grades defined by the Metropolitan Park Commission, and special precautions will be taken to avoid, as far as possible, interference with the natural scenery of the vicinity. For a length of 700 feet, where the sewer passes through private land west of Adams Street, a temporary fence has been erected on the taking lines, on each side of the sewer, and the contractor confines his operations within the enclosure thus formed. Work commenced at the lower end early in October, 1901. About 200 feet of trench have been excavated to date.

Section 54, Quincy.

Division Engineer in Charge. — **Frederick D. Smith.**
Assistant Engineer. — **Seth Peterson.**
Contractor. — **National Contracting Company, New York, N. Y.**

The sewer begins in the location of the Furnace Brook Metropolitan Parkway, at a point about 1,600 feet northeasterly from its junction with Adams Street. It follows the parkway location and Adams Street in a westerly direction to a point in Adams Street, near Eaton's Ice Pond, and has a total length of 1,990 feet. It is 11 feet by 12 feet 3 inches in diameter, constructed in open cut with an average total depth of 18 feet. The excavation is through alluvial soil and sand, overlying large quantities of decayed slate ledge. A small amount of water is found in the excavation. Special precautions are taken to preserve the natural features along the sewer location, and the surplus earth is used in sub-grading a park boulevard, under the direction of the Metropolitan Park Commission's Engineer. Work was commenced November 1, 1901, and 100 feet have been excavated to date.

Section 55, Quincy and Milton.

Division Engineer in Charge. — **Frederick D. Smith.**
Assistant Engineer. — **Seth Peterson.**
Contractor. — **H. P. Nawn, Boston, Mass.**

This sewer, 11 feet by 12 feet in diameter, commences in Adams Street, near Eaton's Ice Pond, in Quincy, and extends in a westerly direction along Adams Street and across the Milton boundary line near Washington Street, to a point near Church Street, in Milton, a total distance of 3,555 feet.

The contract was let as a tunnel section with an average depth of 45 feet below the level of the street. For convenience of working, the contractor has sunk three shafts, one about 800 feet from the lower end, one near Beale Street, and one about 900 feet from the upper end of the section. Work on the upper shaft was commenced as early as December 1, 1900, and on the lower shaft two days later. The middle shaft was commenced April 8, 1901.

An easterly heading from the lower shaft has been driven 472 feet and a westerly heading 478 feet, making 950 feet in all. Of this length, 317 feet were wholly in rock, 155 feet in rock bottom with earth roof, 303 feet in hard-pan, and 105 feet in hard-pan with rock bottom.

From the middle shaft an easterly heading has been driven 366 feet. This was all in hard-pan except for a 60-foot length with sand roof. No westerly heading was driven, the contractor finding it more convenient to open-cut a length of 241 feet in sand, gravel and hard-pan, 45 feet deep, immediately adjoining the shaft. A heading has been begun at the westerly end of this cut, of which 20 feet have been driven to date.

The excavation of the upper shaft, in sand and gravel, with fine sand in the lower 12 feet, proceeded from December 1, 1900, to January 17, 1901, when it was suspended until March 9. It was then continued until the shaft reached grade, late in May. Pumping was then maintained until November 16, when an open cut was started at each end of the shaft. This now extends over a total length, including the shaft, of 132 feet, and is within 3 feet of grade. The flow of ground water through it has been as much as 1,240,000 gallons per day. In the month just closed it varied between 406,000 gallons and 974,000 gallons per day. The effect of the pumping has been observed over an area having a radius of 2,000 feet from the shaft, as indicated by the drying of 51 wells. A temporary town-water service has in each such case been put into the houses. These figures show that a total length of 1,719 feet has been excavated in tunnel and open cut, to date. The masonry sewer structure has been completed in 1,110 feet of this length, in which the sewer arch has been reinforced with concrete for a distance of 762 feet.

The 24-inch Metropolitan water main in Adams Street was moved for a total length of 725 feet, where the contractor found it convenient to open-cut instead of to tunnel.

Section 56, Milton.

Division Engineer in Charge. — Frederick D. Smith.
Assistant Engineer. — Seth Peterson.
Contractor. — National Contracting Company, New York, N. Y.

Commencing near Church Street, this sewer extends northwesterly through Adams Street to a point 800 feet beyond East Milton station, a total distance of about 1,495 feet. It is 10 feet 7 inches by 11 feet 7 inches in diameter, wholly in open cut, at an average depth of 31 feet. For about 350 feet at the westerly end of the section the excavation is in hard-pan, overlying slate ledge; the remainder is in earth, gravel and sand. The rock averaged 13 feet in depth, measured from its surface to the bottom of the trench. A very small amount of water was found throughout the section. Excavation was begun December 3, 1900, and 1,400 feet have been completed to date. Passing the East Milton branch of the New York, New Haven & Hartford Railroad, and for a length of about 300 feet at the lower end of the section, the sewer was reinforced by concrete spandrels carried to a height of 6 inches above the arch, and near the lower end about 125 feet of 24-inch Metropolitan water main were moved in a southerly direction, in order to clear the sewer trench.

An 8-inch branch has been inserted at Granite Avenue and a 15-inch branch near the upper end of the section.

Section 57, Milton.

Division Engineer in Charge. — Frederick D. Smith.
Assistant Engineer. — Seth Peterson.
Contractor. — J. W. Bustin & Co., Syracuse, N. Y.

This sewer, 10 feet 7 inches by 11 feet 7 inches in diameter, follows the centre line of that part of the proposed Milton boulevard extending from Adams Street to Pleasant Street, a distance of 1,874 feet. The work will be in open cut, through sand and gravel, with some clay, at an average depth of 22 feet. Some portions of the line will be covered by a low embankment, formed of surplus material from the trench, carried up to the sub-grade of the boulevard. Excavation was begun October 31, 1901, and about 300 feet have been completed to date. An 8-inch branch has been inserted about 165 feet east of Pleasant Street.

Section 58, Milton.

Division Engineer in Charge. — Frederick D. Smith.
Assistant Engineer. — Seth Peterson.
Contractor. — Latta & Terry Company, Philadelphia, Pa.

This sewer, 10 feet 7 inches by 11 feet 7 inches in diameter, follows the centre line of the proposed Milton boulevard for a length of 2,560 feet, commencing at Pleasant Street and ending in Centre Street. It will be in open cut throughout. Surplus earth from the trench will be used to form an embankment over the greater part of the length, finished at boulevard sub-grade. The average depth of excavation is 17 feet. Excavation will be largely in coarse sand and gravel, with superficial peat for a length of 800 feet near the upper end of the section. The cross-section will be modified in a special structure at Station 14+40, to allow of the passage over it of a double culvert taking the place of an open water course now crossing the boulevard location. Trench has been partially excavated for a length of 600 feet west of Pleasant Street.

Section 59, Milton.

Division Engineer in Charge. — Frederick D. Smith.
Assistant Engineer. — Seth Peterson.
Contractor. — H. P. Nawn, Boston, Mass.

Occupying the centre of the Milton boulevard location, this 10 feet 7 inches by 11 feet 7 inches sewer extends from Centre Street to Randolph Avenue, a distance of 2,567 feet. It will be in open cut, averaging 20 feet in depth below the original surface, with a low embankment, formed of surplus earth from the excavation, over its entire length, finished at boulevard sub-grade. The excavation will be in sand, gravel and clay. About 200 feet of trench have been excavated to grade. An 8-inch branch has been inserted at Centre Street, to provide for unsewered areas in Milton.

Section 60, Milton.

Division Engineer in Charge. — **Frederick D. Smith.**
Assistant Engineer. — **Seth Peterson.**
Contractor. — **J. W. Bustin & Co., Syracuse, N. Y.**

This 10 feet 7 inches by 11 feet 7 inches sewer extends westerly along the centre line of the Milton boulevard location from Randolph Avenue to near Canton Avenue, a distance of 1,609 feet. It will be in open cut, averaging 19 feet deep. An embankment, with a maximum height of 9 feet above the original surface, will be formed of surplus excavated material over the greater part of its length, and finished to boulevard sub-grade. The excavation will be in sand, gravel and clay, with mud and peat extending at one point to a depth of 13 feet. The contract was awarded October 23, 1901, and no progress has been made with excavation.

Section 62, Milton.

Division Engineer in Charge. — **Frederick D. Smith.**
Assistant Engineer. — **Seth Peterson.**
Contractor. — **Ed. W. & J. J. Everson, Providence, R. I.**

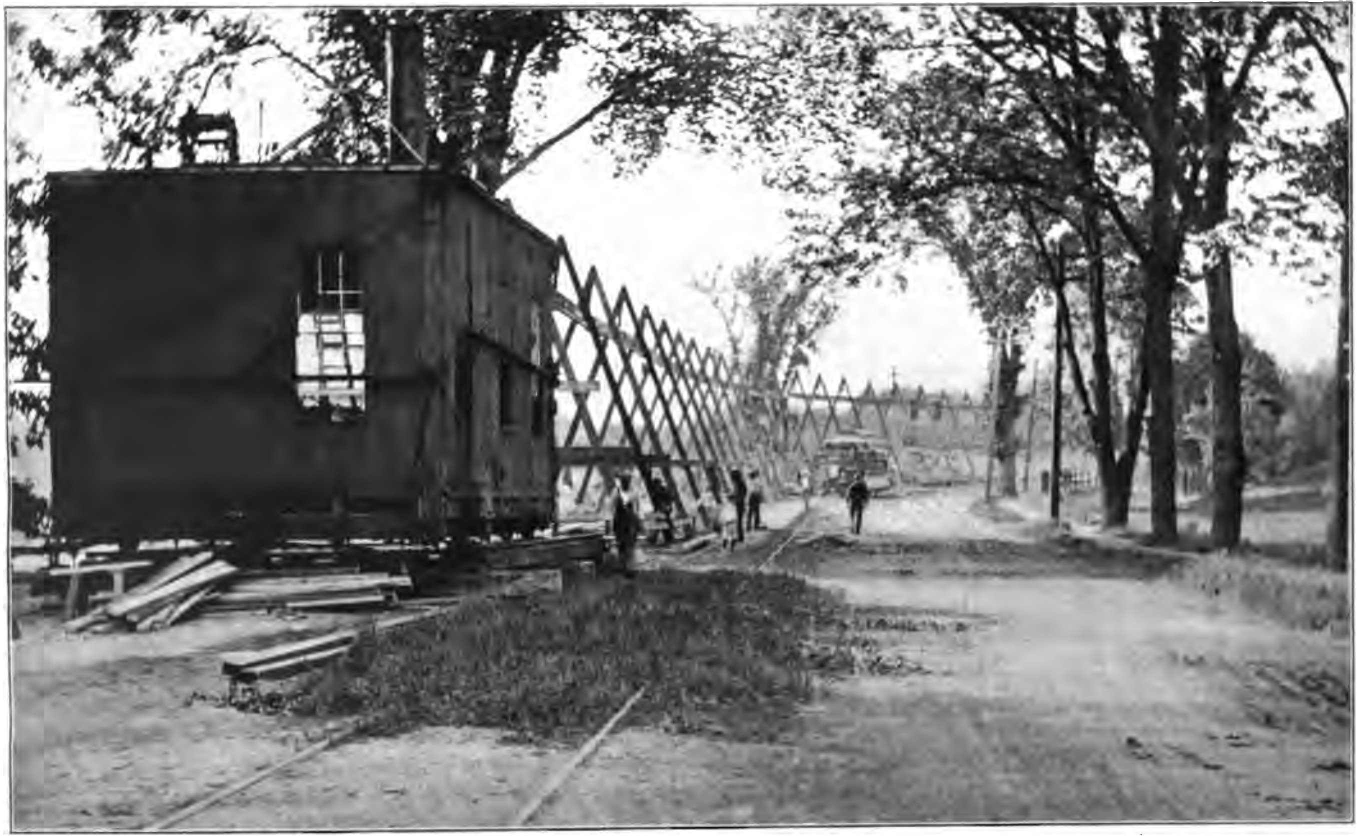
This 10 feet 7 inches by 11 feet 7 inches sewer is located in Brook Road, extending northwesterly from near Pine Tree Brook to a point 530 feet beyond Ridge Road, a distance of 2,174 feet. Of this length, 396 feet, near Ridge Road, are in rock tunnel. The remaining 1,778 feet are in open cut, averaging 27 feet in depth. The excavation in open cut is through sand and gravel, with rock in the bottom for two-thirds of its length at the upper end of the section.

An average of about 400,000 gallons of ground water per day has been pumped from the excavation. Work was begun December 10, 1900. The whole of the excavation in trench and tunnel is completed. About 200 feet of masonry remain to be constructed. Four 8-inch branches have been inserted at intervals of about 200 feet, to provide for unsewered areas in Milton.

Section 63, Milton.

Division Engineer in Charge. — **Frederick D. Smith.**
Assistant Engineer. — **Seth Peterson.**
Contractor. — **National Contracting Company, New York, N. Y.**

This is a 10 feet 7 inches by 11 feet 7 inches sewer, 2,262 feet in length, commencing in Brook Road, at a point 800 feet easterly from the Blue Hills Parkway. It follows Brook Road, crosses the



HIGH LEVEL SEWER — CONSTRUCTION WITH EXCAVATING MACHINE, IN BROOK ROAD, MILTON.

UNIV. OF MICH.

Metropolitan Blue Hills Parkway, and terminates in park lands southeast of the Neponset River. It is wholly in open cut, at an average depth of 25 feet. The excavation is in coarse sand and gravel, with rock in the first 700 feet length. Work was begun December 3, 1900, and 1,882 feet have been excavated to date. West of the Blue Hills Parkway, where the work is being carried on at two openings, the excavation is in wet sand and gravel, and large quantities of ground water are found, approximating 1,000,000 gallons per day at each opening. The arch was reinforced with concrete spandrels for a length of 150 feet near the river, up to the harder ground found near Brush Hill Road, and across the Metropolitan Blue Hills Parkway. An 18-inch branch has been inserted at Brush Hill Road and two 8-inch branches at intervals of about 300 feet.

Section 65, Hyde Park.

Division Engineer in Charge. — **C. Barton Pratt.**
Contractor. — **Beckwith & Quackenbush, Mohawk, N. Y.**

This sewer extends from the Neponset River, through Monponset and Baldwin streets, near the location of the New York, New Haven & Hartford Railroad (Midland Division). Of the total length of 900 feet, 640 feet, between River Street and the Neponset River, are 10 feet 7 inches by 11 feet 7 inches in diameter; the remaining 260 feet, northwest of River Street, are 9 feet 3 inches by 10 feet 2 inches in diameter. The existing Neponset valley sewer, in River Street, is temporarily passed through the completed sewer by a 24-inch cast-iron pipe. Two branches, 4 feet 6 inches in diameter, have been provided in the larger sewer at this point, one for the future connection of the Neponset valley sewer, and the other, on the opposite side, for a main sewer to provide for undrained areas of the city of Boston.

Between River Street and the river the excavation was largely in sand and gravel, with boulders. A small amount of water was found in the excavation. Between River Street and the railroad location the excavation was chiefly in felsite rock. Excavation was commenced on March 3, 1900.

Prior to September 29, 1900, 572 feet of the sewer had been completed. The section was completed on April 12, 1901, giving an average rate of progress, for the entire work, of 16 feet per week, with a maximum of 32 feet per week.

Section 66, Hyde Park.

Division Engineer in Charge. — C. Barton Pratt.
Contractor. — Ed. W. & J. J. Everson, Providence, R. I.

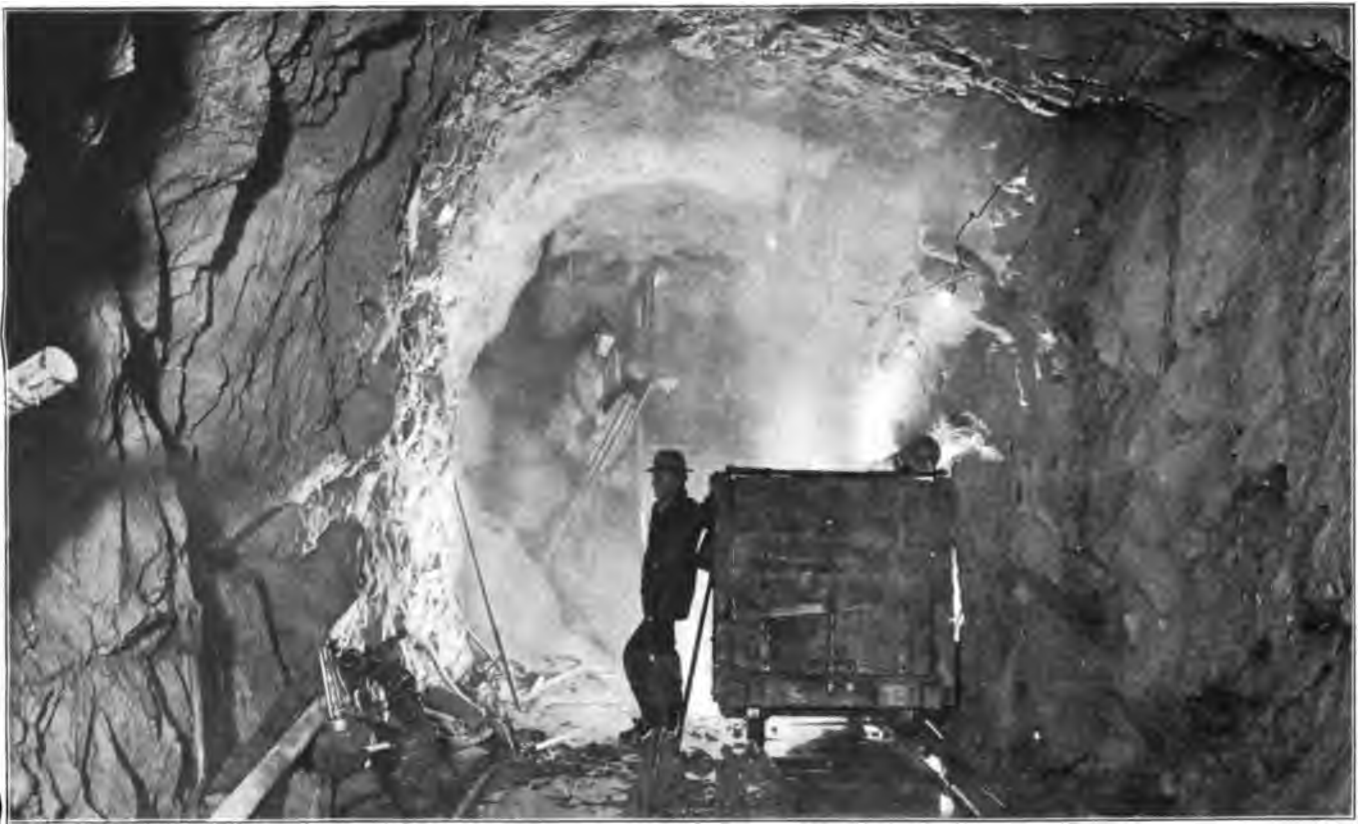
This sewer, 9 feet 3 inches by 10 feet 2 inches in diameter, 5,300 feet in length, was expected to be wholly in tunnel. At the date of the last report (September 29, 1900) 1,188 feet of tunnel excavation had been completed. For a length of 285 feet near Ralston Road, having an approximate depth of 24 feet, the contractor found it more convenient to excavate in open trench than to drive the tunnel as contemplated in the contract. The excavation of the open portion was carried on in August and September, 1901. Except for a length of about 20 feet, it was in rock and boulders, rising to an average of 15 feet above the sewer invert, overlaid by a mixture of hard-pan, sand and gravel. Including this 285 feet length, a total of 5,050 feet has been excavated to date. This indicates that during the fifteen months now under review an average rate of excavation of 60 feet per week has been maintained, rising to a maximum of 90 feet. The excavation in the tunnel headings has been in felsite of a very hard and flinty variety, with occasional trap dikes. No masonry has been introduced into headings to date. Approximately 130 feet of masonry have been built in the open cut. The tunnel excavation has been carried on during the year from the central shaft in Ruskin Road, near the middle of the section, fully described in the last report, and has advanced about equally northeast and southwest thereof.

The single fatality on the high-level sewer construction to date occurred on this section in February, 1901. A laborer, attempting to alight from a moving lift in the Ruskin Road shaft, fell to the bottom of the shaft and was killed.

Section 67, Hyde Park.

Division Engineer in Charge. — Frank I. Capen.

This section has a total length of 327 feet, extending from the upper end of Section 66 tunnel, across Stony Brook, to near the Hyde Park and West Roxbury boundary line. It includes about 215 feet of ordinary 9 feet 3 inches by 10 feet 2 inches sewer structure, at an average depth of 17 feet, and two lines, each 84 feet in length, of 60-inch cast-iron pipe under Stony Brook, with pipe



HIGH LEVEL SEWER — CONSTRUCTION OF TUNNEL IN ROCK IN RUSKIN ROAD, HYDE PARK.

UNIV. OF MICH.

chambers at either end for controlling and diverting the flow of sewage through the individual lines of pipe.

The work is being carried on by day-labor, under the direct supervision of the Engineer. It was begun October 24, 1901. At the present time about 40 feet of pipe have been laid in each line of crossing, and the pipe chambers are well advanced.

Section 68, Hyde Park and West Roxbury.

Division Engineer in Charge. **— C. Barton Pratt.**
Contractor. **— Beckwith & Quackenbush, Mohawk, N. Y.**

Commencing in Hyde Park, near the West Roxbury boundary line, this sewer extends through private lands in West Roxbury, adjacent to Stony Brook, to the junction of Ashland and Canterbury streets; thence along Ashland Street, Hammatt Road and Hadwin Way to Hyde Park Avenue, in West Roxbury, a total distance of 2,738 feet. The length of 1,735 feet below Canterbury Street is 9 feet 3 inches by 10 feet 2 inches in diameter. The remaining 983 feet are 8 feet 9 inches by 9 feet 8 inches. The entire section was completed prior to September 29, 1900, with the exception of 45 feet of the larger sewer near the intersection of Ashland and Canterbury streets. The character of the work was described on page 63 of the previous report.

Excavation was begun November 20, 1899, and the work was completed December 1, 1900, showing an average rate of progress of 51 feet per week. A maximum of 120 feet per week was accomplished.

Two branches were inserted in the larger sewer at Canterbury Street. On the westerly side a 24-inch brick connection, and on the easterly side a 12-inch pipe, were provided for unsewered Boston areas.

Section 69, West Roxbury.

Division Engineer in Charge. **— C. Barton Pratt.**
Contractor. **— Beckwith & Quackenbush, Mohawk, N. Y.**

This sewer, 8 feet 9 inches by 9 feet 8 inches in diameter and 2,596 feet in length, is in Hyde Park Avenue, between Hadwin Way and Larch Place. It was commenced November 29, 1899, and on September 29, 1900, a length of 1,990 feet had been completed, as detailed on page 63 of the previous report.

The work was in open trench, with an average depth of 26 feet.

For a length of 900 feet from the commencement of the work, in Hadwin Way, the excavation was in gravel and clay, with hard-pan and some ledge in the bottom. Between stations 9 + 00 and 17 + 00 it was in sand, very fine towards the bottom, and involving, for a length of 300 feet near Mount Hope station, the use of tubular wells to secure a foundation. From Station 17 + 00 to the upper end of the section the excavation was similar to the first 900 feet.

The upper length of 609 feet, constructed during the period now under review, was in sand, clay and hard-pan, in open trench with an average depth of about 30 feet. For 100 feet near Larch Place, at the upper end of the section, rock was found in the bottom of the trench, rising to an average height of 6 feet above sewer grade. The section was completed July 6, 1901. This indicates a rate of progress, for the entire work, of 30 feet per week, with a maximum of 95 feet.

A 12-inch pipe was inserted in the sewer, near Mount Hope Street, to provide for unsewered areas of the city of Boston.

Section 70, West Roxbury.

Division Engineer in Charge. — C. Barton Pratt.
Contractor. — Charles Linehan, Cambridge, Mass.

This sewer extends from Hyde Park Avenue, through Larch Place, under the main line of the New York, New Haven & Hartford Railroad, through the extension of Harrison Street, along private lands adjoining the railroad and Stony Brook, under Washington Street and in private lands to South Street, at Bussey arch, and along South Street to Bussey Street. The total length of the section is 3,740 feet, but the actual length of sewer included in the contract is 230 feet less, owing to the omission of two lengths in the line, referred to on page 64 of the previous report. The sewer is 8 feet 9 inches by 9 feet 8 inches in diameter, and is built partly in open cut and partly in embankment. At the date of the previous report 1,230 feet of sewer were completed. At the present time 3,260 feet have been completed, leaving only 200 feet in Larch Place and 50 feet in embankment on the meadows near Stony Brook to be constructed. This indicates an average rate of progress, during the fifteen months under review, of 31 feet per week. A maximum of 45 feet per week has been reached. Under the railroad location the sewer arch has been reinforced with concrete spandrels, carried up to 6 inches above the arch. A branch, about 3 feet in diameter, has been provided in Harrison Street for the connection of a main sewer from unsewered areas of the city of Boston.

Section 71, West Roxbury.

Division Engineer in Charge. — **C. Barton Pratt.**
Contractor. — **Charles F. Taylor & Co., Syracuse, N. Y.**

Of the total length of 2,193 feet of 8 feet 9 inches by 9 feet 8 inches sewer comprising this section, 188 feet are in tunnel, the remaining 2,005 feet in open trench. The open trench extends along South Street, from Bussey Street to the entrance to Bussey Woods, and thence through private lands for a further distance of 1,000 feet. The line then re-enters South Street in the short tunnel which completes the section.

For a length of 443 feet in private lands the sewer is in shallow open cut, finished by an embankment about 3 feet above the outside of the sewer arch, extended to join the slope of the hill on the west.

The average depth of excavation in the open trench in South Street was about 18 feet; in the open cut and embankment it was about 8 feet. The tunnel was in sand and gravel. The open cut was principally in sand and gravel, with some clay. Rock was found about 200 feet from the beginning of the section, and beds of peat extended below the elevation of the sewer foundation for a length of 175 feet near Station 15+00. The peat was removed and replaced by concrete filling. A maximum volume of 500,000 gallons of ground water per day was handled by the pumps.

At the close of the last report about 1,100 feet, including the tunnel, had been completed. The remainder of the section was completed on July 19, 1901. The average rate of progress per week, over the entire section, was 8 feet in tunnel and 33 feet in the remainder of the work. A maximum of 120 feet per week was attained in open cut and embankment.

Section 72, West Roxbury.

Division Engineer in Charge. — **C. Barton Pratt.**
Contractor. — **Jones & Meehan, Boston, Mass.**

This 8 feet 9 inches by 9 feet 8 inches sewer is 3,010 feet in length. It extends from near the Bussey Institution, along South Street, across the Arborway and still along South Street to the easterly side of St. Joseph Street. From the beginning of the section to the northeasterly margin of the Arborway, a length of 1,140 feet, the sewer is in tunnel, at an average depth of about 38 feet. The remainder is in trench, averaging 20 feet in depth.

Work was commenced on two tunnel shafts and the open cut October 8, 1900. The excavation in both tunnel and open cut was mainly in sand and gravel, with a small amount of water. Near St. Joseph Street, for a length of 300 feet, the lower portion of the trench was in fine sand, moving under a head of water. Three driven wells assisted in completing the trench excavation and securing a stable foundation for the sewer structure. The entire sewer in this length was built in Portland concrete and Portland brickwork. Portland concrete spandrels were also carried up to the height of the top of the arch. The character of the excavation in this 300 feet length considerably delayed the completion of the section. Crossing under the Goldsmith Brook conduit, at St. Joseph Street, the arch was depressed 2½ feet, and the section reinforced with tie-rods and rolled beams.

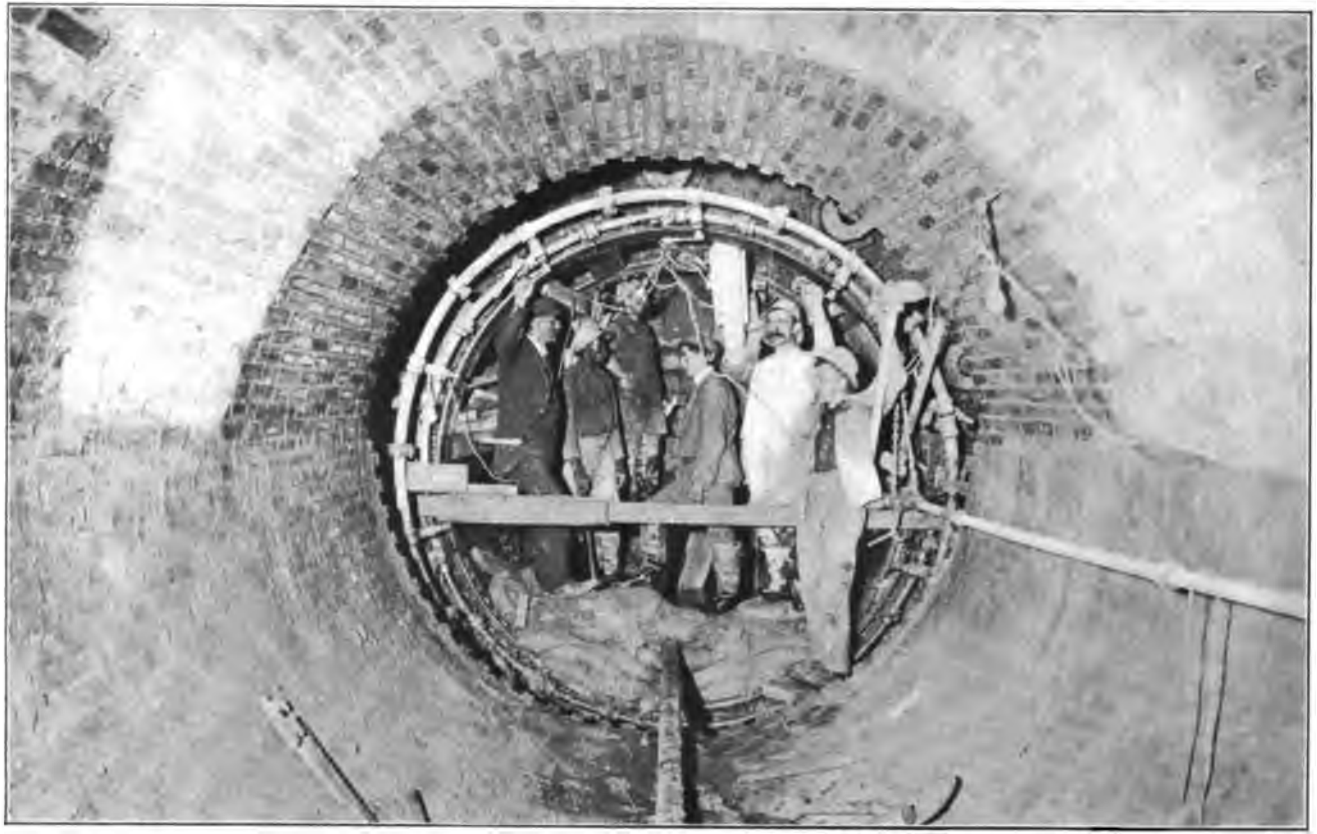
The open cut was completed October 1, 1901, indicating an average rate of trench excavation of 39 feet per week, with a maximum of 150 feet. The whole of the tunnel, with the exception of 40 feet, has been excavated during the period under review. The average rate of excavation in tunnel was 17 feet per week, with a maximum of 46 feet.

Section 73, West Roxbury.

Division Engineer in Charge. — C. Barton Pratt.
Contractor. — National Contracting Company, New York, N. Y.

This 9-foot circular sewer, in South and Centre streets, extends from near St. Joseph Street to near Boylston Street, a distance of 4,775 feet. The entire length is designed to be in tunnel, at an average depth of about 50 feet. In view of the probable use of compressed air with shields in the whole or portions of the work, a circular cross-section is adopted in place of the usual horse-shoe type of sewer.

Of the total length of 4,775 feet, about 1,400 feet of the tunnel headings will be in Roxbury pudding-stone, and the remainder in sand. Two shafts have been sunk to grade, one near Lakeville Place, in rock; the other at Pond Street, in sand. The excavation



HIGH LEVEL SEWER — CONSTRUCTION OF CIRCULAR TUNNEL WITH AIR COMPRESSOR AND METALLIC SHIELD, IN CENTRE STREET, JAMAICA PLAIN.

UNIV. OF MICH.

at the former was begun December 1, 1900, and completed February 7, 1901. The latter was begun February 1 and completed May 1, 1901. To date, 1,350 feet of rock heading have been excavated, located about equally north and south of the shaft in Lakeville Place. About 100 feet of concrete invert have been built in this length.

At the Pond Street shaft a metallic shield and air compressors were installed July 1, 1901, and a start was made to drive a southerly heading from this shaft by the pneumatic process. To date, no substantial progress has been made with this portion of the section.

Section 74, West Roxbury and Roxbury.

Division Engineer in Charge. — **C. Barton Pratt.**
Contractor. — **H. P. Nawn, Boston, Mass.**

Commencing in Centre Street, near Boylston Street, in West Roxbury, this sewer extends through Centre and Day streets to near Heath Street, in Roxbury, a distance of 2,985 feet, at an average depth of 54 feet, increasing to 65 feet. It is wholly in rock tunnel, with the exception of 190 feet of open cut, in sand and gravel, between Hutchins Avenue and Minden Street. Of the total length, the lower portion, below Perkins Street, nearly 1,000 feet in length, is 8 feet 3 inches by 9 feet 2 inches in diameter. A reduction in size to 6 feet 6 inches by 7 feet takes place in a bell-mouth junction at this point, from which the main line of the high-level sewer will ultimately be extended to Newton and other areas, for the relief of the existing low level sewers in the Charles River valley. The smaller sewer included in this section forms the lower end of the branch sewer intended mainly for the reception of sewage to be lifted at the proposed pumping station in Ward Street.

Work was begun September 26, 1900. The tunnel excavation is completed. The sewer has been constructed in the open cut and in about 1,800 feet of the tunnel portion, leaving about 1,000 feet of heading in which the masonry has yet to be completed.

The rate of excavation through the rock tunnel for the smaller sewer has averaged 31 feet per week, with a maximum of 60 feet. In the tunnel for the larger sewer it averaged 24 feet, rising to a maximum of 40 feet per week.

Near Grotto Glen an 18-inch brick connection has been left in the easterly side of the sewer.

Section 75, Roxbury.

Division Engineer in Charge. — C. Barton Pratt.
Original Contractor. — Shailer-Schniglau Company, Chicago, Ill.
Contractor for Parts of Section. — Ed. W. & J. J. Everson, Providence, R. I.

This is a tunnel section, largely in rock, consisting of 3,070 feet of 6 feet 6 inches by 7 feet sewer, passing under Parker Hill, at a maximum depth of 175 feet. Commencing at the junction of Day and Heath streets, the sewer passes under private lands and across intersecting streets for a distance of 1,700 feet. It then enters Calumet Street and continues along St. Alphonsus Street to a point about midway between Tremont and Smith streets. It will end at this point in a special bell-mouth structure, designed to receive the delivery ends of the two 48-inch force mains from the Ward Street pumping station.

Work was commenced on the Day Street shaft May 17, 1900. The last report, pages 67 and 68, contains a detailed description of the peculiar geological formation through which the first 288 feet of heading were driven.

Between September 29, 1900, and August 26, 1901, a further length of 612 feet was driven and lined with masonry. The excavation has been largely in boulder clay or hard-pan. At the northerly end of the heading, for a length of 50 feet, the conglomerate or pudding-stone gradually rises from the bed of the tunnel until it occupies the whole heading. The structure in the greater part of this length is reinforced with Portland concrete, and the arch is built in Portland brickwork. On December 22, 1900, the contractor began to sink a second shaft, 65 feet deep, on St. Alphonsus Street, near Alleghany Street. This shaft is entirely in Roxbury pudding-stone, which rises to the surface at this point. It was completed, and work started on the headings in each direction, March 6, 1901, when work at this shaft was suspended. On August 26 the entire work was abandoned by the contractor. The remainder of the section was advertised, and a contract for it awarded to Ed. W. & J. J. Everson of Providence, R. I., who have carried on the work since October 11. From that date until December 18 the contractor was pumping out the shaft, erecting machinery and preparing for work in the headings. From December 18 to date about 50 feet of heading have been driven.

Section 76, Roxbury.

This section will consist of two lines of 48-inch cast-iron force main, connecting the proposed pumping station on Ward Street with the 6 feet 6 inches by 7 feet sewer on St. Alphonsus Street. The lines will aggregate 3,000 feet in length. There have been purchased from the water works division and delivered on the pumping station lot 480 feet of 48-inch pipe, together with a pipe derrick and appurtenances, at a cost of $3,567.84.

Section 77, Roxbury.

This section includes the pumping station and connections with the suction sewer and force mains. The pumping station lot, comprising an area of about 100,000 square feet, located at the southeasterly angle of Ward and Vancouver streets, was purchased January 19, 1900, for $61,300.20. Studies have been made of foundations for engines and pumps, and the connection of the plant with the suction sewer and force mains. A contract for two 50,000,000-gallon, vertical, triple-expansion, 60-inch stroke pumping engines, with boilers and other appurtenances, has been awarded to the Allis-Chalmers Company of Milwaukee, Wis., for the sum of $204,000. The engines are to be erected, ready for service, within two years. The temporary buildings on the pumping station lot have been removed, and the lot cleared in readiness for building operations.

CEMENT TESTING.

About 59,000 barrels of Portland and 24,000 barrels of Rosendale cement have been used during the fifteen months under review. The cement was subjected to the usual careful tests for fineness, tensile strength, specific gravity, checking, cracking, etc. The results under the first two heads are summarized in the following table: —

Summary of Cement Tests made by Metropolitan Sewerage Works, October 1, 1900, to December 31, 1901.

BRAND.	Number of Barrels used.	Composition of Briquettes.	FINENESS.			TWENTY-FOUR HOURS.		SEVEN DAYS.		TWENTY-EIGHT DAYS.		THREE MONTHS.		SIX MONTHS.		NINE MONTHS.		ONE YEAR.		EIGHTEEN MONTHS.		TWO YEARS.	
			Per Cent. Residue No. 50 Sieve.	Per Cent. Residue No. 100 Sieve.	Per Cent. Residue No. 120 Sieve.	Briquettes.	Pounds per Square Inch.	Briquettes.	Pounds per Square Inch.	Briquettes.	Pounds per Square Inch.	Briquettes.	Pounds per Square Inch.	Briquettes.	Pounds per Square Inch.	Briquettes.	Pounds per Square Inch.	Briquettes.	Pounds per Square Inch.	Briquettes.	Pounds per Square Inch.	Briquettes.	Pounds per Square Inch.
Portland.																							
Alpha,	2,831	Neat,	0	9.7	12.7	155	341	169	806	15	911	5	893	5	721	-	-	5	802	-	-	-	-
		2:1,	0	9.7	12.7	-	-	165	348	20	492	5	623	5	594	-	-	5	594	-	-	-	-
Atlas,	28,890	Neat,	0	9.8	12.2	715	386	827	690	170	796	5	881	5	879	5	777	10	822	-	-	-	-
		2:1,	0	9.8	12.1	-	-	785	364	180	435	40	569	10	566	10	653	35	499	-	-	5	682
Catskill,	287	Neat,	0	13.6	15.8	10	346	40	654	24	766	-	-	-	-	5	884	5	818	-	-	-	-
		2:1,	0	13.6	15.7	-	-	25	339	15	485	5	774	-	-	5	552	5	579	-	-	-	-
Lehigh,	13,320	Neat,	0	10.0	13.5	350	358	360	741	80	862	10	759	10	852	-	-	5	1,086	-	-	-	-
		2:1,	0	10.0	13.4	-	-	324	392	100	486	30	552	10	596	-	-	5	561	-	-	-	-
Star,	9,030	Neat,	0	9.4	11.9	280	346	225	754	50	850	5	814	-	-	5	1,038	14	814	5	702	-	-
		2:1,	0	9.6	12.0	-	-	224	372	70	443	15	377	-	-	5	549	10	585	5	545	5	582
Vulcanite,	4,840	Neat,	0	9.6	11.7	210	338	225	816	40	898	5	590	5	623	-	-	5	1,003	5	979	-	-
		2:1,	0	9.5	11.6	-	-	185	465	40	494	25	626	5	553	-	-	5	553	5	597	-	-
Totals,	59,198	Neat,	0	9.8	12.5	1,720	364	1,846	731	379	831	30	783	25	785	15	900	44	867	10	841	-	-
		2:1,	0	9.8	12.4	-	-	1,708	380	425	458	120	588	30	579	20	602	65	535	10	571	10	632
Rosendale.																							
Crescent,	55	Neat,	3.0	15.0	20.0	10	187	10	180	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		1½:1,	3.0	15.0	20.0	-	-	10	76	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hoffman,	7,183	Neat,	3.4	15.3	17.5	165	146	170	170	45	261	-	-	-	-	-	-	-	-	-	-	-	-
		1½:1,	3.3	15.3	17.5	-	-	135	68	45	169	10	295	-	-	-	-	-	-	-	-	-	-
Newark and Rosendale,	12,225	Neat,	3.8	15.7	18.2	370	143	441	156	90	215	10	301	-	-	5	412	15	339	-	-	5	351
		1½:1,	4.0	16.0	18.6	-	-	395	70	75	150	5	306	5	304	5	238	10	201	5	267	5	281
Norton,	1,198	Neat,	3.2	13.5	15.8	170	149	215	155	49	190	15	303	-	-	-	-	5	363	-	-	-	-
		1½:1,	3.1	13.4	15.7	-	-	215	68	45	161	5	247	-	-	-	-	5	247	-	-	-	-
Olympia,	3,162	Neat,	3.7	16.3	18.5	100	168	114	172	15	236	-	-	5	364	10	322	10	327	-	-	-	-
		1½:1,	3.7	16.3	18.6	-	-	123	66	20	156	5	240	5	257	-	-	10	194	-	-	5	238
Totals,	23,823	Neat,	3.6	15.2	17.6	815	149	950	161	199	220	25	302	5	364	15	352	30	339	-	-	5	351
		1½:1,	3.6	15.3	17.8	-	-	878	68	185	158	25	276	10	281	5	238	25	207	5	267	10	291

MAINTENANCE.

SCOPE OF WORK AND FORCE EMPLOYED.

In addition to the construction already described, the maintenance of the Metropolitan sewerage systems involves the operation of 5 pumping stations, with about 82 miles of Metropolitan sewers receiving sewage discharged into them at 240 points by 830 miles of town and city sewers, and the care and study of siphons crossing under rivers and tidal creeks.

At the present time there is a total maintenance force of 83 men. This includes 45 engineers and other employés at the pumping stations, and 38 men who care for pumping station grounds and 82 miles of Metropolitan sewers with special structures. Five teams are also employed.

The three following tables show in detail the use made of the completed systems: —

NORTH METROPOLITAN SYSTEM.

Table showing Cities and Towns delivering Sewage to this System; Approximate Miles of Sewer connected; Estimated Populations and Areas now contributing; Total Areas ultimately to contribute, and Present Populations on Such Areas; Ratios of Present Contributing Areas to Ultimate Areas, and Ratios of Populations now contributing to Present Total Populations.

[Populations of May 1, 1901.]

CITIES AND TOWNS.	Miles of Local Sewer connected.	Separate or Combined.	Number of Connections with Local Sewers.	Estimated Number of Persons served by Each House-connection.*	Estimated Population now contributing Sewage.	Estimated Present Total Population.	Estimated Area now contributing Sewage.	Area ultimately to contribute Sewage.	Ratio of Contributing Population to Present Total Population.	Ratio of Contributing Area to Ultimate Area.
							Square Miles.	Square Miles.	Per Cent.	Per Cent.
Boston (Deer Island), .	0.30	Separate, .	-	-	1,300†	1,300	-	-	100.0	-
Winthrop, ...	25.43	Separate, .	1,501	4.3	6,454	6,900	1.19	1.61	93.5	73.9
Boston (East Boston), .	20.00	Separate and combined.	4,900	8.8	43,120	46,800	0.71	2.18	92.1	32.6
Chelsea, ...	7.96	Combined, .	1,280	6.7	8,576‡	35,300	0.38	2.24	24.3	17.0
Everett, ...	34.87	Separate, .	2,746	5.6	15,378	26,700	1.68	3.34	57.6	50.3
Malden, ...	44.55	Separate, .	3,587	5.2	18,652	35,800	2.49	5.07	52.1	49.1
Melrose, ...	30.51	Separate, .	1,986	4.1	8,143	13,600	1.48	3.73	60.0	39.7
Boston (Charlestown), .	20.40	Separate and combined.	5,000	7.9	39,500§	40,800	0.64	1.27	96.8	50.4
Cambridge, ...	111.28	Separate and combined.	13,768	6.8	93,622	96,500	4.92	6.11	97.0	80.5
Somerville, ...	79.65	Separate and combined.	11,605	5.3	61,507	65,600	3.27	3.96	93.8	82.6
Medford, ...	45.61	Separate, .	2,502	5.5	13,761	20,100	2.39	8.35	68.5	28.6
Winchester, ...	18.62	Separate, .	599	5.2	3,115	7,800	0.95	5.95	40.0	16.0
Woburn, ...	12.22	Separate, .	774‖	5.4	4,180	14,700	0.89	12.71	28.5	7.0
Stoneham, ...	10.38	Separate, .	361	4.3	1,552	6,300	0.56	5.50	24.6	10.2
Arlington, ...	17.90	Separate, .	629	6.2	3,900	9,400	1.62	5.20	41.5	31.2
Belmont, ...	6.13	Separate, .	183	6.3	1,578¶	4,500	0.76	4.66	35.0	16.3
Wakefield,** . . .	-	-	-	-	-	9,900	-	7.65	-	-
Lexington,** . . .	-	-	-	-	-	2,800	-	5.11	-	-
Total, ...	485.81	-	51,421	6.3	324,338	444,800	23.93	84.64	72.9	28.3

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* Estimated from assessors' statement of the number of houses in each city or town, and the population from census of 1900 extended to 1901.

† Estimated by Superintendent J. R. Gerrish of the Institution on Deer Island.

‡ The Pearl Street district of Chelsea temporarily excluded, owing to connection not being properly maintained.

§ Including 30 persons at navy yard.

¶ Including 2 connections with McLean Hospital, having an estimated population of 420.

‖ Exclusive of Mystic valley sewer and tanneries.

** Wakefield and Lexington not connected.

SOUTH METROPOLITAN SYSTEM.

Table showing Cities and Towns delivering Sewage to this System; Approximate Miles of Sewer connected; Estimated Populations and Areas now contributing; Total Areas ultimately to contribute, and Present Populations on Such Areas; Ratios of Present Contributing Areas to Ultimate Areas, and Ratios of Populations now contributing to Present Total Populations.

[Populations of May 1, 1901.]

CITIES AND TOWNS.	Miles of Local Sewer connected.	Separate or Combined.	Number of Connections with Local Sewers.	Estimated Number of Persons served by Each House-connection.*	Estimated Population now contributing Sewage.	Estimated Present Total Population.	Estimated Area now contributing Sewage.	Area ultimately to contribute Sewage.	Ratio of Contributing Population to Present Total Population.	Ratio of Contributing Area to Ultimate Area.
							Square Miles.	Square Miles.	Per Cent.	Per Cent.
Boston (Back Bay), .	20.70	Separate and combined.	1,300	15.8	20,540	21,600	1.12	1.61	95.1	69.6
Boston (Brighton), .	50.20	Separate and combined.	2,330	5.6	13,048	20,800	3.09	4.27	62.7	72.4
Brookline, . . .	51.18	Separate and combined.	2,575	6.5	16,738	21,800	2.92	6.81	76.8	42.9
Newton, ...	91.57	Separate, .	4,265	5.6	23,884	36,300	6.12	18.03	65.8	33.9
Watertown, . . .	29.97	Separate, .	1,404	5.0	6,950	10,500	1.67	4.04	66.2	41.3
Waltham, . . .	38.12	Separate, .	2,520	5.2	13,104	24,900	2.40	13.63	52.6	17.6
Boston (Dorchester), .	12.47	Separate and combined.	944	6.8	6,419	36,600	0.80	4.89	17.5	16.4
Milton, ...	3.24	Separate and combined.	69	5.4	378	7,100	0.18	12.59	5.3	1.4
Hyde Park, . . .	15.82	Separate, .	516	7.9	4,079	18,900	0.84	4.57	29.3	18.4
Dedham, ...	1.27	-	7	7.1	50	7,100	0.06	9.40	0.7	0.6
Boston (Roxbury), .	-	-	-	-	-	28,200	-	1.23	-	-
Boston (West Roxbury),	3.70	Separate, .	130	7.2	936	25,900	0.21	8.92	3.6	2.3
Quincy, ...	26.00	-	665	6.0	4,000	25,800	1.34	12.56	15.5	10.7
Total, . . .	344.24	-	16,725	6.6	110,121	280,500	20.75	102.55	39.3	20.2

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* Estimated from assessors' statement of the number of houses in each city or town, and the population from census of 1900 extended to 1901.

East Boston Pumping Station.

At this station are three submerged centrifugal pumps, with impellers or wheels 8.25 feet in diameter, driven by triple-expansion engines of the Reynolds-Corliss type.

Contract capacity of pumps: 45,000,000 gallons each, with 19-foot lift.
Average duty for the year: 57,800,000 foot-pounds.
Average quantity raised each day, 49,200,000 gallons.
Force employed: 3 engineers, 3 firemen, 6 screenmen and 1 reliefman.
Coal used: first-quality Cumberland, costing from $3.95 to $3.98 per ton.

Table of Approximate Quantities, Lifts and Duties at the East Boston Pumping Station of the North Metropolitan System.

Months.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ft.-lbs. per 100 lbs. Coal).
1900-1901.						
October, ...	1,245,500,000	40,200,000	29,100,000	70,100,000	15.04	54,500,000
November, . . .	1,238,600,000	41,300,000	31,900,000	84,200,000	15.07	54,100,000
December, . . .	1,508,800,000	48,700,000	36,300,000	83,300,000	15.32	54,800,000
January, ...	1,314,700,000	42,400,000	31,900,000	61,300,000	15.11	54,400,000
February, ...	1,135,000,000	40,500,000	33,500,000	47,600,000	15.12	57,200,000
March, ...	1,782,600,000	57,500,000	37,300,000	98,200,000	15.68	64,400,000
April, ...	2,447,500,000	81,600,000	60,500,000	123,300,000	16.33	68,900,000
May, ...	2,255,900,000	72,800,000	56,100,000	111,800,000	16.12	65,000,000
June, ...	1,436,700,000	47,900,000	39,300,000	66,400,000	15.16	58,700,000
July, ...	1,292,500,000	41,700,000	31,400,000	65,600,000	14.98	55,800,000
August, ...	1,250,500,000	40,300,000	34,000,000	66,700,000	14.95	55,500,000
September, . . .	1,206,000,000	40,200,000	34,600,000	58,100,000	14.99	55,500,000
October, ...	1,241,400,000	40,000,000	33,800,000	64,400,000	14.94	55,300,000
November, . . .	1,192,600,000	39,800,000	29,800,000	81,400,000	14.95	52,600,000
December, . . .	1,950,200,000	62,900,000	36,300,000	118,300,000	15.67	60,600,000
Total, ...	22,498,500,000	-	-	-	-	-
Average, . . .	-	49,200,000	37,000,000	79,700,000	15.30	57,800,000

CHARLESTOWN PUMPING STATION.

At this station are three submerged centrifugal pumps, two of them having impellers or wheels 7.5 feet in diameter, the other 8.25 feet in diameter. They are driven by triple-expansion engines of the Reynolds-Corliss type.

Contract capacity of pumps: two, 22,000,000 gallons each, with 11-foot lift; one, 60,000,000 gallons, with 8-foot lift.
Average duty for the year: 53,500,000 foot-pounds.
Average quantity raised each day: 30,700,000 gallons.
Force employed: 3 engineers, 3 firemen, 6 screenmen and 1 reliefman.
Coal used: first-quality Cumberland, costing from $3.95 to $3.98 per ton.

Table of Approximate Quantities, Lifts and Duties at the Charlestown Pumping Station of the North Metropolitan System.

MONTHS.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ft.-lbs. per 100 lbs. Coal).
1900-1901.						
October,	916,200,000	29,600,000	24,100,000	39,100,000	7.75	57,100,000
November,	851,000,000	28,400,000	20,400,000	41,400,000	7.76	53,200,000
December,	953,600,000	30,800,000	25,800,000	40,700,000	7.90	59,800,000
January,	913,700,000	29,500,000	23,500,000	38,300,000	8.15	60,100,000
February,	802,300,000	28,600,000	23,000,000	32,600,000	7.90	54,000,000
March,	997,700,000	32,200,000	22,800,000	45,500,000	8.22	56,600,000
April,	1,185,800,000	39,500,000	28,800,000	58,900,000	8.69	65,600,000
May,	1,146,100,000	37,000,000	28,300,000	51,000,000	8.37	60,100,000
June,	904,000,000	30,100,000	23,900,000	37,800,000	8.00	52,200,000
July,	874,200,000	28,200,000	22,400,000	38,600,000	7.88	46,600,000
August,	896,500,000	28,900,000	25,900,000	38,500,000	7.96	50,700,000
September,	857,200,000	28,600,000	24,200,000	35,800,000	7.89	47,800,000
October,	852,400,000	27,500,000	21,100,000	37,000,000	7.65	45,600,000
November,	801,600,000	26,700,000	18,200,000	44,500,000	7.65	45,800,000
December,	1,066,300,000	34,400,000	22,300,000	53,600,000	8.04	47,400,000
Total,	14,018,600,000	-	-	-	-	-
Average,	-	30,700,000	23,600,000	42,200,000	7.99	53,500,000

ALEWIFE BROOK PUMPING STATION.

The plant at this station consists of the original installation of small commercial pumps and engines, *i.e.*, two 9-inch Andrews vertical centrifugal pumps, with direct-connected compound marine engines, together with the recent additions. The latter consist of a specially designed engine of the vertical cross-compound type, having between the cylinders a centrifugal pump rotating on a horizontal axis.

Contract capacity of the two original pumps: 4,500,000 gallons each, with 13-foot lift.
Contract capacity of new pump: 13,000,000 gallons, with 13-foot lift.
Average duty for the year: 18,900,000 foot-pounds.
Average quantity raised each day: 3,780,000 gallons.
Force employed: 2 engineers and 1 laborer.
Coal used: first-quality Cumberland, costing from $4.23 to $4.45 per ton.

Table of Approximate Quantities, Lifts and Duties at the Alewife Brook Pumping Station of the North Metropolitan System.

MONTHS.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ft.-lbs. per 100 lbs. Coal).
1900-1901.						
October, ...	87,699,000	2,829,000	1,784,000	6,813,000	13.30	13,800,000
November, . . .	87,487,000	2,916,000	1,580,000	6,990,000	13.06	15,800,000
December, . . .	115,189,000	3,716,000	2,414,000	5,882,000	13.04	19,600,000
January, ...	90,051,000	2,905,000	2,330,000	4,376,000	13.26	17,900,000
February, ...	80,345,000	2,869,000	2,414,000	3,279,000	13.30	17,200,000
March, ...	130,245,000	4,202,000	2,414,000	7,462,000	12.97	21,300,000
April, ...	204,306,000	6,810,000	5,106,000	9,350,000	12.88	30,200,000
May, ...	207,778,000	6,702,000	4,376,000	8,229,000	12.80	28,200,000
June, ...	128,412,000	4,280,000	2,833,000	6,076,000	13.09	19,800,000
July, ...	95,805,000	3,090,000	2,246,000	6,400,000	13.31	15,600,000
August, ...	91,671,000	2,957,000	2,162,000	5,882,000	13.11	14,000,000
September, . . .	88,012,000	2,934,000	2,246,000	4,376,000	13.10	14,500,000
October, ...	89,770,000	2,896,000	2,204,000	5,300,000	13.09	15,000,000
November, . . .	88,456,000	2,948,000	1,700,000	6,076,000*	12.97	17,500,000
December, . . .	144,201,000	4,652,000	2,228,000	8,052,000	13.06	23,000,000
Total, ...	1,729,422,000	-	-	-	-	-
Average, . . .	-	3,780,000	2,536,000	6,303,000	13.09	18,900,000

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* Exclusive of days when tide water was pumped for engine testing purposes.

QUINCY PUMPING STATION.

[Operated by the Commonwealth since April 1, 1901.]

At this station are two compound condensing Deane pumping engines.

Contract capacity of pumps: one, 3,000,000 gallons, the other, 5,000,000 gallons, with 36-foot lift.
Average duty for the year: 26,900,000 foot-pounds.
Average quantity raised each day: 2,014,000 gallons.
Force employed: 3 engineers.
Coal used: first-quality Cumberland, costing from $4.25 to $4.75 per ton.

Table of Approximate Quantities, Lifts and Duties at the Quincy Pumping Station of the South Metropolitan System.

MONTHS.	Total Pumpage (Gallons).	Average per Day (Gallons).	Minimum Day (Gallons).	Maximum Day (Gallons).	Average Lift (Feet).	Average Duty (ft.-lbs. per 100 lbs. Coal).
1901.						
April,	85,800,000	2,860,000	2,327,000	3,743,000	42.32	33,000,000
May,	81,489,000	2,629,000	2,226,000	3,242,000	41.06	31,000,000
June,	62,239,000	2,075,000	1,668,000	2,585,000	37.38	29,300,000
July,	53,819,000	1,736,000	1,481,000	2,074,000	33.68	25,000,000
August,	47,682,000	1,538,000	1,361,000	1,785,000	32.48	23,400,000
September,	45,842,000	1,528,000	1,318,000	2,030,000	32.23	23,500,000
October,	53,263,000	1,718,000	1,420,000	2,207,000	32.04	24,700,000
November,	49,945,000	1,665,000	1,381,000	2,061,000	33.45	24,100,000
December,	73,778,000	2,380,000	1,630,000	4,348,000	36.58	28,000,000
Total,	553,857,000	-	-	-	-	-
Average,	-	2,014,000	1,645,000	2,675,000	35.69	26,900,000

In the following tables the total cost of pumping and the rate per million foot-gallons at each of the five pumping stations are shown in detail: —

Average Cost per Million Foot-gallons for Pumping at the Deer Island Station.

Volume (23,782.3 Million Gallons) × Lift (11.47 Feet) = 272,783 Million Foot-gallons.

ITEMS.	Cost.	Cost per Million Foot-gallons.
Labor,	$12,401 12	$0.04547*
Coal,	7,553 61	.02769
Oil,	262 13	.00096
Waste,	32 91	.00012
Water,	1,740 40	.00638
Packing,	85 41	.00031
Miscellaneous supplies and renewals,	1,467 61	.00538
Total,	$23,543 19	$0.08631

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* Includes labor at screens; deducting this item gives cost of labor $0.03032. Deducting labor at screens gives cost of pumping $0.07116.

Average Cost per Million Foot-gallons for Pumping at the East Boston Station.

Volume (22,498.5 Million Gallons) × Lift (15.3 Feet) = 344,227 Million Foot-gallons.

ITEMS.	Cost.	Cost per Million Foot-gallons.
Labor,	$11,969 67	$0.03477*
Coal,	9,005 14	.02616
Oil,	202 80	.00059
Waste,	49 64	.00014
Water,	1,042 30	.00303
Packing,	74 72	.00022
Miscellaneous supplies and renewals,	1,845 04	.00536
Total,	$24,188 81	$0.07027

* Includes labor at screens; deducting this item gives cost of labor $0.02351. Deducting labor at screens gives cost of pumping $0.05901.

Average Cost per Million Foot-gallons for Pumping at the Charlestown Station.

Volume (14,018.6 Million Gallons) × Lift (7.99 Feet) = 112,009 Million Foot-gallons.

ITEMS.	Cost.	Cost per Million Foot-gallons.
Labor,	$11,180 58	$0.09981*
Coal,	3,433 19	.03065
Oil,	233 25	.00208
Waste,	86 24	.00077
Water,	493 60	.00443
Packing,	199 72	.00178
Miscellaneous supplies and renewals,	829 90	.00741
Total,	$16,456 48	$0.14693

* Includes labor at screens; deducting this item gives cost of labor $0.06660. Deducting labor at screens gives cost of pumping $0.11372.

Average Cost per Million Foot-gallons for Pumping at the Alewife Brook Station.

Volume (1,729.4 Million Gallons) × Lift (13.09 Feet) = 22,638 Million Foot-gallons.

ITEMS.	Cost.	Cost per Million Foot-gallons.
Labor,	$3,690 89	$0.16305
Coal,	1,939 25	.08567
Oil,	228 61	.01010
Waste,	29 51	.00130
Water,	358 98	.01586
Packing,	29 40	.00130
Miscellaneous supplies and renewals,	178 84	.00790
Total,	$6,455 48	$0.28518

Average Cost per Million Foot-gallons for Pumping at the Quincy Station.

Volume (553.86 Million gallons) × Lift (35.69 Feet) = 19,767 Million Foot-gallons.

Items.	Cost.	Cost per Million Foot-gallons.
Labor,	$2,476 47	$0.12528
Coal,	1,268 73	.06418
Oil,	33 19	.00168
Waste,	6 22	.00031
Water,	82 56	.00418
Packing,	21 46	.00109
Miscellaneous supplies and renewals,	525 06	.02656
Total,	$4,413 71	$0.22328

MATERIAL INTERCEPTED AT THE SCREENS.

At the three main line stations the sewage, before reaching the pumps, is passed through cages, set in pairs in the lower sewer and raised or lowered by steam power.

The total amount of material, consisting of paper, rags and other miscellaneous matter, intercepted at the screens of the main line stations of the North Metropolitan System, during the fifteen months under review, was about 1,500 cubic yards, or about 1.7 cubic feet per million gallons pumped at Deer Island.

CARE OF SPECIAL STRUCTURES.

Studies of the flow in the Metropolitan sewers, siphons and outfall pipes indicate that these are free from deposit and in a satisfactory condition.

Respectfully submitted,

WM. M. BROWN,
Engineer, Metropolitan Sewerage Works.

BOSTON, December 31, 1901.

UNIV. OF MICH.

APPENDIX.

APPENDIX No. 1.

CONTRACTS MADE AND PENDING DURING

Contracts relating to the

[NOTE. — The details of contracts made before

	1. Number of Contract.	2. WORK.	3. Number of Bids.	Amount of Bid.		6. Contractor.
				4. Next to Lowest.	5. Lowest.	
1	150†	Excavating soil,	9	$116,831 00	$116,546 00*	Moulton & O'Mahoney,
2	166	Excavating soil,	6	1,248,400 00	1,096,300 00*	Nawn & Brock,
3	183	Excavating soil,	5	238,500 00*	230,685 00	Long & Little,
4	210	Excavating soil from Section 8 of the Wachusett Reservoir, and completing the westerly portion of the North Dike, Clinton, Boylston and Sterling, Mass.	3	377,830 00	360,870 00*	Newell & Snowling Construction Company, Uxbridge, Mass.
		Total,				

Contracts relating to the

5	195	Wachusett Dam,	11	$1,680,870 00	$1,603,635 00*	McArthur Bros. Company.
6	223	78 tons special castings,	2	7,416 65	6,651 56*	Camden Iron Works, Camden, N. J.
7	Special Order.	Furnishing 8 24-inch and 4 48-inch flange-end water valves and 4 48-inch bell-end water valves.	2	16,528 00	14,512 00*	Chapman Valve Manufacturing Company, Indian Orchard, Mass.
8	Special Order.	13.5 tons special castings,	1	-	1,014 00*	Taunton Locomotive Manufacturing Company, Taunton, Mass.
		Total,				

Contracts relating to the

9	3-M.†	Steel stairway,	2	$1,498 00	$1,165 00*	G. P. Bullard & Co.,
10	214	Excavating mud and earth from that portion of Lake Cochituate known as Snake Brook Meadow, in Wayland and Natick, building embankments and facing them with gravel.	8	17,225 00	16,850 00*	Long & Little, Leominster, Mass.
		Total,				

* Contract based upon this bid. † Contract completed.

APPENDIX No. 1.

THE YEAR 1901 — WATER WORKS.

Reservoir Department.

1901 have been given in previous reports.]

7. Date of Contract.	8. Date for Completion of Contract.	9. Date of Final Estimate.	10. Prices of Principal Items of Contracts made in 1901.	11. Amount of Contract.	12. Value of Work done Dec. 31, 1901.	
April 10, '99,	June 1, '00,	Jan. 21, '01,	- -	$157,130 37	$157,130 37	1
June 13, '99,	Dec. 1, '02,	-	- -	1,096,300 00	727,900 00	2
Dec. 12, '99,	July 1, '03,	-	- -	238,500 00	174,400 00	3
Aug. 1, '01,	Nov. 1, 04,	-	For clearing and grubbing, $55 per acre; for soil excavation, $0.27, $0.33, $0.37 and $0.39 per cu. yd.; for earth excavation, $0.22 and $0.18 per cu. yd.; for gravel excavation, $0.27 per cu. yd.	360,870 00	39,700 00	4
. . .	. . .	. . .	. . . .	$1,852,800 37	$1,099,130 37	
Dam and Aqueduct Department.						
Oct. 1, '00,	Nov. 15, '04,	-	- -	$1,603,635 00	$190,218 24	5
Nov. 25, '01,	June 1, '02,	-	$85.20 per ton of 2,000 lbs., delivered at Berlin, Mass.	6,651 56	-	6
Nov. 27, '01,	April 15, '02,	-	24-inch valves, $446 each; 48-inch flange-end valves, $1,636 each; 48-inch bell-end valves, $1,100 each.	14,512 00	-	7
Dec. 14, '01,	April 15, '02,	-	$75 per ton of 2,000 lbs., delivered at Berlin, Mass.	1,014 00	-	8
. . .	. . .	. . .	. . . .	$1,625,812 56	$190,218 24	
Sudbury Department.						
Oct. 19, '00,	Dec. 1, '00,	April 18, '01,	- -	$1,323 20	$1,323 20	9
Sept. 11, '01,	Dec. 15, '01,	-	For mud and earth excavation, $0.24 per cu. yd.; for gravel excavation, $0.25 per cu. yd.	14,000 00	12,000 00	10
. . .	. . .	. . .	. . . .	$15,323 20	$13,323 20	

CONTRACTS MADE AND PENDING DURING THE

Contracts relating to the

	1. Number of Contract.	2. WORK.	3. Number of Bids.	AMOUNT OF BID. 4. Next to Lowest.	5. Lowest.	6. Contractor.
1	199	Section 2, Weston Aqueduct, 3,700 feet in tunnel, 4,755 feet in open trench.	8	$234,581 50	$200,477 00*	Shanahan, Casparis & Co., Louisville, Ky., and Columbus, O.
2	200	Section 3, Weston Aqueduct, 2,150 feet in tunnel, 3,350 feet in open trench.	9	131,226 10	127,507 50*	Shanahan, Casparis & Co., Louisville, Ky., and Columbus, O.
3	201	Section 4, Weston Aqueduct, 4,155 feet in open trench.	19	68,810 50	64,888 50*	Patrick McGovern, Boston, Mass.

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* Contract based upon this bid.

YEAR 1901 — WATER WORKS — *Continued.*

Weston Aqueduct Department.

7. Date of Contract.	8. Date for Completion of Contract.	9. Date of Final Estimate.	10. Prices of Principal Items of Contracts made in 1901.	11. Amount of Contract.	12. Value of Work done Dec. 31, 1901.	
May 9, '01,	Aug. 1, '03,	-	For earth excavation, $0.37 per cu. yd.; for rock excavation, $1.40 per cu. yd.; for excavation from tunnels: No. 1, $2.60 per cu. yd.; No, 2, $5.25 per cu. yd.; for brick masonry, laid in natural cement mortar: in open trench, $11.75 per cu. yd.; in tunnel, $12 per cu yd.; for natural cement concrete masonry in open trench, $4 per cu. yd.; for Portland cement concrete masonry: in open trench, $5.50 per cu. yd.; lining in tunnel, $6.25 and $5.75 per cu. yd.; for dimension stone masonry, laid in mortar, $37 per cu. yd.; for face dressing of pointed work, $0 40 per sq. ft.; for dry rubble stone masonry, $3 per cu. yd.; for dry rubble stone paving, $1.90 per cu. yd.	$200,477 00	$46,090 00	1
May 9, '01,	Aug. 1, '03,	-	For earth excavation, $0.32 per cu. yd.; for rock excavation, $1.40 per cu. yd.; for excavation from tunnel, $5.25 per cu. yd.; for brick masonry, laid in natural cement mortar, $11.75 per cu. yd.; for natural cement concrete masonry in open trench, $4 per cu. yd.; for Portland cement concrete masonry: in open trench, $5.50 per cu. yd.; lining in tunnel, $6.25 and $5.75 per cu. yd.; for dimension stone masonry laid in mortar, $37 per cu. yd.; for face dressing of pointed work, $0.40 per sq. ft.; for dry rubble stone masonry, $3 per cu. yd.; for dry rubble stone paving, $1 90 per cu. yd.	127,507 50	27,594 00	2
May 6, '01,	Aug. 1, '03,	-	For earth excavation, $0.27 per cu. yd.; for borrowed earth, $0.23 per cu. yd.; for rock excavation, $2.10 per cu. yd.; for brick masonry, laid in natural cement mortar, $11.25 per cu. yd.; for natural cement concrete masonry, $3.90 per cu. yd.; for Portland cement concrete masonry, $5.25 per cu. yd.; for dimension stone masonry, laid in mortar, $50 per cu. yd.; for face dressing of pointed work, $0.25 per sq. ft.; for dry rubble stone masonry, $3.50 per cu. yd.; for dry rubble stone paving, $2 per cu. yd.	64,888 50	46,926 00	3

CONTRACTS MADE AND PENDING DURING

Contracts relating to the

	1. Number of Contract.	2. WORK.	3. Number of Bids.	AMOUNT OF BID. 4. Next to Lowest.	 5. Lowest.	6. Contractor.
1	202	Section 5, Weston Aqueduct, 5,295 feet in open trench, including a railroad crossing.	16	$139,023 00	$137,526 50*	Bruno, Salomone & Petitti, Boston, Mass.
2	203	Section 6, Weston Aqueduct, 4,520 feet in open trench, including siphon chamber.	14	121,497 00	120,646 50*	Shanahan, Casparis & Co., Louisville, Ky., and Columbus, O.
3	204	Section 12, Weston Aqueduct, 6,500 feet in open trench.	16	139,197 50	134,096 50*	Shanahan, Casparis & Co., Louisville, Ky., and Columbus, O.

* Contract based upon this bid.

THE YEAR 1901 — WATER WORKS — *Continued.*

Weston Aqueduct Department — Continued.

7. Date of Contract.	8. Date for Completion of Contract.	9. Date of Final Estimate.	10. Prices of Principal Items of Contracts made in 1901.	11. Amount of Contract.	12. Value of Work done Dec. 31, 1901.	
May 3, '01,	Aug. 1, '03,	-	For earth excavation, $0.27 per cu. yd.; for borrowed earth, $0.20 per cu. yd.; for rock excavation, $1 per cu. yd.; for brick masonry laid in natural cement mortar, $11.50 per cu. yd.; for natural cement concrete masonry, $4.70 per cu. yd.; for Portland cement concrete masonry, $5.30 per cu. yd.; for dimension stone masonry, laid in mortar, $20 per cu. yd.; for face dressing of pointed work, $0.25 per sq. ft.; for dry rubble stone masonry, $4 per cu. yd.; for dry rubble stone paving, $4 per cu. yd.; for railroad crossing, $200.	$137,526 50	$51,480 00	1
May 9, '01,	Aug. 1, '03,	-	For earth excavation, $0.35 per cu. yd.; for borrowed earth, $0.25 per cu. yd.; for rock excavation, $1.50 per cu. yd.; for brick masonry, laid in natural cement mortar, $11.50 per cu. yd.; for natural cement concrete masonry, $4 per cu. yd.; for Portland cement concrete masonry, $5.50 per cu. yd.; for dimension stone masonry, laid in mortar, $35 per cu. yd.; for face dressing of pointed work, $0.40 per sq. ft.; for dry rubble stone masonry, $3 per cu. yd.; for dry rubble stone paving, $1.90 per cu. yd.	120,646 50	24,151 00	2
May 9, '01,	Aug. 1, '03,	-	For earth excavation, $0.24 per cu. yd.; for borrowed earth, $0.19 per cu. yd.; for rock excavation, $1.50 per cu. yd.; for brick masonry, laid in natural cement mortar, $11.25 per cu. yd.; for natural cement concrete masonry, $3.55 per cu. yd.; for Portand cement concrete masonry, $5.10 per cu. yd.; for dimension stone masonry, laid in mortar, $35 per cu. yd.; for face dressing of pointed work, $0.40 per sq. ft.; for dry rubble stone masonry, $3 per cu. yd.; for dry rubble stone paving, $1.90 per cu. yd.	134,096 50	32,475 00	3

CONTRACTS MADE AND PENDING DURING

Contracts relating to the

	1.	2.	3.	Amount of Bid.		6.
	Number of Contract.	WORK.	Number of Bids.	4. Next to Lowest.	5. Lowest.	Contractor.
1	205	Section 13, Weston Aqueduct, 5,600 feet in tunnel, 1,700 feet in open trench.	9	$364,884 00	$346,290 00*	Michael H. Keefe, Yonkers, N. Y. Assigned on Oct. 12, 1901, to Columbus Construction Co., New York, N. Y.
2	208	Castings for siphon chamber.	4	11,340 00	10,908 00*	Henry R. Worthington, New York, N. Y.
3	211	Sections 8 and 10, Weston Aqueduct, 6,390 feet in open trench, including 8 siphon chambers.	11	155,508 50	146,189 00*	Winston & Co., Clinton, Mass.

* Contract based upon this bid.

THE YEAR 1901 — WATER WORKS — *Continued.*

Weston Aqueduct Department — Continued.

7. Date of Contract.	8. Date for Completion of Contract.	9. Date of Final Estimate.	10. Prices of Principal Items of Contracts made in 1901.	11. Amount of Contract.	12. Value of Work done Dec. 31, 1901.	
May 20, '01,	Aug. 1, '03,	-	For earth excavation, $0.60 per cu. yd.; for borrowed earth, $0.25 per cu. yd.; for rock excavation $0.80 per cu. yd.; for excavation from tunnel, $6 per cu. yd.; for brick masonry in open trench, laid in natural cement mortar, $12 per cu. yd.; for natural cement concrete masonry, in open trench, $5 per cu. yd.; for Portland cement concrete masonry: in open trench, $6 per cu. yd., for lining in tunnel, $6.25 and $5 per cu. yd.; for dimension stone masonry, laid in mortar, $30 per cu. yd.; for face dressing of pointed work, $0.50 per sq. ft.; for dry rubble stone masonry, $2.50 per cu. yd.; for dry rubble stone paving, $2 per cu. yd.	$346,290 00	$46,065 00	1
May 21, '01,	April 1, '02,	-	For 12 sets castings, $10,908,	10,908 00	2,780 00	2
Aug. 28, '01,	Aug. 1, '03,	-	For earth excavation, $0.30 per cu. yd.; for borrowed earth, $0.18 per cu. yd.; for rock excavation, $1.75 per cu. yd.; for brick masonry, laid in natural cement mortar, $11 per cu. yd.; for natural cement concrete masonry, $3.85 per cu. yd.; for Portland cement concrete masonry, $5.30 per cu. yd.; for dimension stone masonry, laid in mortar, $50 per cu. yd.; for face dressing of pointed work, $0.60 per sq. ft.; for dry rubble stone masonry, $4 per cu. yd.; for dry rubble stone paving, $4 per cu. yd.	146,139 00	11,351 00	3

CONTRACTS MADE AND PENDING DURING

Contracts relating to the

	1. Number of Contract.	2. WORK.	3. Number of Bids.	AMOUNT OF BID. 4. Next to Lowest.	5. Lowest.	6. Contractor.
1	212	Section 11, Weston Aqueduct, 6,600 feet in trench.	10	$157,270 00	$148,635 00*	Winston & Co., Clinton, Mass.
2	213	Section 15, Weston Aqueduct, 600 feet in tunnel, 5,125 feet in open trench, also excavation from portion of Weston Reservoir and construction of portion of dam and drain.	5	197,556 00	171,645 00*	Winston & Co., Clinton, Mass.
3	218	Section 14, Weston Aqueduct, open channel and upper portion of reservoir.	10	68,364 00	58,490 00*	Nawn & Brock, Boston, Mass.

* Contract based upon this bid.

THE YEAR 1901 — WATER WORKS — *Continued.*

Weston Aqueduct Department — Continued.

7. Date of Contract.	8. Date for Completion of Contract.	9. Date of Final Estimate.	10. Prices of Principal Items of Contracts made in 1901.	11. Amount of Contract.	12. Value of Work done Dec. 31, 1901.	
Aug. 28, '01,	Aug. 1, '03,	-	For earth excavation, $0.32 per cu. yd.; for borrowed earth, $0.25 per cu. yd.; for rock excavation, $1.50 per cu. yd.; for brick masonry, laid in natural cement mortar, $11 per cu. yd.; for natural cement concrete masonry, $3.80 per cu. yd.; for Portland cement concrete masonry, $5.30 per cu. yd.; for dimension stone masonry, laid in mortar, $50 per cu. yd.; for face dressing of pointed work, $0.60 per sq. ft.; for dry rubble stone masonry, $4 per cu. yd.; for dry rubble stone paving, $4 per cu. yd.	$148,635 00	-	1
Aug. 28, '01,	Aug. 1, '03,	-	For earth excavation: in open trench, $0.42 per cu. yd., in reservoir, $0.37 per cu. yd.; for borrowed earth, $0.32 per cu. yd.; for rock excavation, $1.40 per cu. yd.; for excavation from tunnel, $5 per cu. yd.; for brick masonry, in open trench, laid in natural cement mortar, $11 per cu. yd.; for natural cement concrete masonry, in open trench, $3 80 per cu. yd.; for Portland cement concrete masonry: in open trench, $5.10 per cu. yd., for lining in tunnel, $7 and $6 per cu. yd.; for dimension stone masonry, laid in mortar, $30 per cu. yd.; for face dressing of pointed work, $0.55 per sq. ft.; for dry rubble stone masonry, $3 per cu. yd.; for dry rubble stone paving, $3 per cu. yd.	171,645 00	$4,384 00	2
Nov. 26, '01,	Aug. 1, '03,	-	For earth excavation, $0.23 per cu. yd.; for rock excavation, $1.50 per cu. yd.; for riprap, $1 per cu. yd.; for slope paving, $2 per cu. yd.; for Portland cement concrete masonry, $5 and $5.50 per cu. yd.; for ashlar masonry, $18 per cu. yd.; for dimension stone masonry, $30 per cu. yd.; for face dressing of pointed work, $0 40 per sq. ft.; for laying 36-inch cast-iron pipe, $1 per lin. ft.	58,490 00	-	3

CONTRACTS MADE AND PENDING DURING

Contracts relating to the

	1. Number of Contract.	2. WORK.	3. Number of Bids.	AMOUNT OF BID. 4. Next to Lowest.	5. Lowest.	6. Contractor.
1	219	Section 1 of the Weston Reservoir, central portion.	11	$64,971 25	$59,587 50*	Nawn & Brock, Boston, Mass.
2	220	Section 2 of the Weston Reservoir, lower portion of reservoir, including dam and concrete drain.	9	90,152 50	88,292 50*	Nawn & Brock, Boston, Mass.
3	Special Order.†	19 tons 16-inch and 12 tons 12-inch cast-iron water pipe, and 2 tons special castings.	3	777 00	768 90*	United States Cast Iron Pipe and Foundry Company, Philadelphia, Pa.
		Total, ...	. .	. . .	. . .	. . . .

Contracts relating to the

4	72†	8 pumping engines, . .	5	$195,000 00	$136,500 00*	Holly Manufacturing Company.
5	122†	Pumping engine, . .	4	64,000 00	62,500 00*	Holly Manufacturing Company.
6	126†	Low-service pumping station.	9	193,050 00	182,659 50*	Norcross Bros, . .
7	137†	Spot Pond pumping station.	10	110,822 50	108,480 00*	McNeil Bros., . .
8	171†	8 sluice gates, . . .	8	10,639 00	8,986 00*	The Atlantic Works, .
9	185†	Gate-house, . . .	9	10,399 00	9,974 00*	John S. Jacobs & Son,
10	192†	Forbes Hill Reservoir, .	13	86,355 00	84,736 00*	Beckwith & Quackenbush.
11	194†	Forbes Hill standpipe, .	4	4,498 00	4,425 00*	Walsh's Holyoke Steam Boiler Works.
12	196†‡	Tunnel under Mystic River.	1	-§	-§	Charles A. Haskin, .
13	1-M.†‡	Tubular boilers, . .	2	6,550 00	4,900 00*	Lake Erie Boiler Works.
14	206	Masonry water tower on Forbes Hill, Quincy, Mass.	4	24,973 00	24,790 00*	J. E. McCoy, Boston, Mass.

* Contract based upon this bid.

‡ This contract charged to maintenance.

† Contract completed.

§ Competitive bids were not received on this contract.

THE YEAR 1901 — WATER WORKS — *Continued.*

Weston Aqueduct Department — Concluded.

7. Date of Contract.	8. Date for Completion of Contract.	9. Date of Final Estimate.	10. Prices of Principal Items of Contracts made in 1901.	11. Amount of Contract.	12. Value of Work done Dec. 31, 1901.	
Nov. 26, '01,	Aug. 1, '03,	-	For earth excavation, $0.25 per cu. yd.; for rock excavation, $1.50 per cu. yd.; for riprap, $1 per cu. yd.; for furnishing and laying 18 and 20 inch sewer pipe for drains and culvert, $2.50 per lin. ft.	$59,587 50	-	1
Nov. 26, '01,	Aug. 1, '03,	-	For clearing and grubbing, $100 per acre; for earth excavation, $0.29, $0.34 and $0.80 per cu. yd.; for rock excavation, $1.30 and $2.50 per cu. yd.; for riprap, $1 per cu. yd.; for slope paving, $2.50 per cu. yd.; for Portland cement concrete masonry, $5 and $5 50 per cu. yd.; for dimension stone masonry, $40 per cu. yd.; for face dressing of pointed work, $0.50 per sq. ft.; for laying 16-inch cast-iron pipe, $0.75 per lin. ft.	88,292 50	-	2
May 9, '01,	-	June 19, '01,	Pipes, $21.90, special castings, $45, per ton of 2,000 lbs.	792 23	$792 23	3
. . .	. . .	. . .	. . . .	$1,815,921 73	$294,038 23	

Distribution Department.

7. Date of Contract.	8. Date for Completion of Contract.	9. Date of Final Estimate.	10. Prices of Principal Items of Contracts made in 1901.	11. Amount of Contract.	12. Value of Work done Dec. 31, 1901.	
Oct. 20, '97,	July 20, '99,	Sept. 11, '01,	- -	$150,784 62	$150,784 62	4
Sept. 20, '98,	Jan. 20, '00,	Nov. 6, '01,	- -	78,139 38	78,139 38	5
Aug. 26, '98,	July 15, '99,	May 2, '01,	- -	200,549 82	200,549 82	6
Jan. 7, '99,	Dec. 15, '99,	May 24, '01,	- -	122,181 08	122,181 08	7
June 23, '99,	Jan. 1, '00,	July 31, '01,	- -	9,262 00	9,262 00	8
April 21, '00,	Oct. 1, '00,	June 4, '01,	- -	9,974 00	9,974 00	9
July 7, '00,	Dec. 1, '00,	Dec. 24, '01,	- -	37,258 61	37,258 61	10
July 20, '00,	Nov. 1, '00,	Jan. 15, '01,	- -	4,529 72	4,529 72	11
Aug. 2, '00,	Nov. 1, '00,	Mar. 6, '01,	- -	20,507 81	20,507 81	12
Sept. 26, '00,	Nov. 15, '00,	July 25, '01,	- -	4,900 00	4,900 00	13
May 23, '01,	Nov. 1, '01,	-	For whole work, $24,790, .	24,790 00	15,500 00	14

CONTRACTS MADE AND PENDING DURING

Contracts relating to the

	1. Number of Contract.	2. WORK.	3. Number of Bids.	AMOUNT OF BID.		6. Contractor.
				4. Next to Lowest.	5. Lowest.	
1	207†	Laying water pipes in Stoneham, Mass., Section 29 of the distribution system.	6	$22,646 10	$20,907 50*	The C. H. Eglee Company, Boston, Mass.
2	209	Bear Hill Reservoir in Stoneham, Mass.	6	19,456 00*	16,950 00	The C. H. Eglee Company, Boston, Mass.
3	215†	Connection chamber at Chestnut Hill.	3	1,658 00	1,552 00*	Norcross Bros., Boston, Mass.
4	216	8,900 tons cast-iron water pipes, 7,600 tons 48-inch, 1,100 tons 60-inch, 100 tons special castings.	2	48-inch pipes, $25.80 per ton; special castings, $60 per ton ‡	48-inch pipes, $22.87 per ton; special castings, $59 per ton.*	United States Cast Iron Pipe and Foundry Company, New York, N. Y.
5	217	8,950 tons cast-iron water pipes, 5,590 tons 48-inch, 3,360 tons 60-inch, 100 tons special castings §	1	-	48-inch pipe, $23.87 per ton; 60-inch pipe, $26.90 per ton: special castings, $75 per ton.*	United States Cast Iron Pipe and Foundry Company, New York, N. Y.
6	221	39 water valves, 10 36-inch, 8 24-inch, 6 16-inch, 15 12-inch.	4	12,650 00	11,940 00*	Geo. F. Blake Manufacturing Company, New York, N. Y.
7	222	284 tons special castings,§	2	23,727 64	22,894 25*	Geo. F. Blake Manufacturing Company, New York, N. Y.
8	Special Order.†	50 tons 12-inch cast-iron water pipes.	3	1,080 00	1,075 00*	United States Cast Iron Pipe and Foundry Company, New York, N. Y.
9	Special Order.†	5 20-inch water gates, .	2	1,500 00	1,075 00*	Coffin Valve Company, Boston, Mass.
10	Special Order.†	Hydraulic cylinder for 36-inch valve and 16-inch check valve.	1	-	1,099 00*	Coffin Valve Company, Boston, Mass.
11	Special Order.†	Furnishing and erecting 3 20-inch sluice gates and 1 12 inch sluice gate.	2	1,372 00	1,010 00*	Coffin Valve Company, Boston, Mass.
		Total, ...	. .	. . . .	. . . .	. . . .

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* Contract based upon this bid. † Contract completed.

‡ Bid did not conform with specifications regarding time of delivery, and was informal.

§ Includes pipes and castings supplied to other departments.

THE YEAR 1901 — WATER WORKS — *Continued.*

Distribution Department — Concluded.

7. Date of Contract.	8. Date for Completion of Contract.	9. Date of Final Estimate.	10. Prices of Principal Items of Contracts made in 1901.	11. Amount of Contract.	12. Value of Work done Dec. 31, 1901.	
June 22, '01,	Sept. 15, '01,	Dec. 11, '01,	For laying cast-iron pipe: 24-inch, $1.30 per lin. ft., 20-inch, $1.08 per lin. ft.; for laying cable, $0.05 per lin. ft.; for rock excavation, above grade, $3 per cu. yd.; for brick chambers: for 20-inch valves, $50 each; for small valves, $30 each.	$20,450 12	$20,450 12	1
July 16, '01,	Nov. 15, '01,	-	For earth excavation, $0.40 per cu. yd.; for rock excavation, $1.95 per cu. yd.; for Portland cement concrete masonry, $7 per cu. yd.; for paving set in mortar, $3 per cu. yd.; for riprap, $1.50 per cu. yd.; for granite dimension stone masonry, $50 per cu. yd.	19,456 00	17,720 21	2
July 5, '01,	-	Oct. 24, '01,	For building complete, $1,552.	1,552 00	1,552 00	3
Nov. 21, '01,	Dec. 1, '02,	-	48-inch pipe, $22.87; 60-inch pipe, $26.90; special castings, $59 per ton of 2,000 lbs., delivered in Newton, Mass.	218,876 00	-	4
Nov. 21, '01,	Dec. 1, '02,	-	48-inch pipe, $23.87; 60-inch pipe, $26.90; special castings, $75 per ton of 2,000 lbs., delivered at Glenwood, Newton, Fayville and Berlin, Mass.	231,817 30	-	5
Nov. 30, '01,	Aug. 30, '02,	-	36-inch valves, $678; 24-inch valves, $273; 16-inch valves, $161; 12-inch valves, $134.	11,940 00	-	6
Nov. 25, '01,	Sept. 1, '02,	-	$78 to $88 per ton of 2,000 lbs., delivered at Glenwood, Newton, Fayville and Berlin, Mass.	22,894 25	-	7
April 18, '01,	May 1, '01,	June 5, '01,	$21.50 per ton of 2,000 lbs., .	1,075 00	1,077 72	8
May 16, '01,	-	Oct. 2, '01,	$215 each, ...	1,075 00	1,075 00	9
July 8, '01,	-	Oct. 18, '01,	Hydraulic cylinder, $950; 16-inch check valve, $149.	1,099 00	1,099 00	10
July 15, '01,	-	Dec. 4, '01,	20-inch sluice gates, $273 each; 12-inch sluice gate, $191.	1,010 00	1,010 00	11
. . .	. . .	. . .	. . . .	$1,188,616 71	$697,566 09	

CONTRACTS MADE AND PENDING DURING THE YEAR 1901 — WATER WORKS — *Concluded.*

Summary of Contracts.*

	Approximate Amount of Contracts.	Value of Work done December 31, 1901.
Wachusett Reservoir, 4 contracts,	$1,852,800 37	$1,099,130 37
Wachusett Dam, 2 contracts,	1,610,286 56	190,218 24
Sudbury Department, 1 contract,	14,000 00	12,000 00
Weston Aqueduct and Reservoir, 14 contracts,	1,815,129 50	293,246 00
Distribution Department, 16 contracts,	1,158,949 90	667,896 56
Total of 37 contracts made and pending during the year 1901,	$6,451,166 33	$2,262,491 17
194 contracts completed in 1896, 1897, 1898, 1899 and 1900,	6,862,991 67	6,862,991 67
	$13,314,158 00	$9,125,482 84
Deduct for work done on 11 Sudbury Reservoir contracts by the city of Boston,	512,000 00	512,000 00
Total of 231 contracts,	$12,802,158 00	$8,613,482 84

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* In this summary, contracts charged to maintenance are excluded.

APPENDIX No. 2.

CEMENT TESTS.

The following tables contain: —

1. Long-time tests of cements used by the Dam and Aqueduct and Reservoir departments during the years 1896 to 1900, inclusive. The tests for shorter periods were published in Appendix No. 3 of the last annual report of the Metropolitan Water Board, and are omitted this year.

2. All tests of cement used in the construction of the Wachusett Dam during the year 1901.

3. Tests of all cements used in the construction of the Weston Aqueduct during the year 1901.

The methods of testing were the same as described in Appendix No. 3 of the report of the Metropolitan Water Board for the year 1897.

Tabulation of Cement Tests for All Brands of Natural Cement, of which Nine Hundred Barrels or More were used on Construction Work by the Dam and Aqueduct and Reservoir Departments from 1896 to 1900, Inclusive.

BRAND.	Number of Barrels used.	Composition of Briquette.	TENSILE STRENGTH.					
			TWO YEARS.		THREE YEARS.		FIVE YEARS.	
			Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.
Beach,	8,880	Neat,	64	467	50	482	-	-
		1 to 1,	64	816	50	849	-	-
Hoffman,	45,845	Neat,	106	467	82	497	18	518
		1 to 1,	106	827	82	847	18	881
Norton,	60,877	Neat,	60	440	54	456	-	-
		1 to 1,	60	295	54	814	-	-
Union,	900	Neat,	22	409	10	474	-	-
		1 to 1,	22	570	10	617	-	-
Total,	115,502	Neat,	252	456	196	480	18	518
		1 to 1,	252	838	196	852	13	881

Tabulation of Cement Tests for All Brands of Portland Cement, of which Nine Hundred Barrels or More were used on Construction Work by the Dam and Aqueduct and Reservoir Departments from 1896 to 1900, Inclusive.

BRAND.	Number of Barrels used.	Composition of Briquette.	TENSILE STRENGTH.							
			EIGHTEEN MONTHS.		TWO YEARS.		THREE YEARS.		FIVE YEARS.	
			Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.
Atlas,	18,509	Neat,	65	848	80	818	55	796	-	-
		2 to 1,	65	824	80	825	55	340	-	-
Brooks-Shoobridge,	5,706	Neat,	5	674	55	702	50	684	15	678
		2 to 1,	5	521	55	447	50	458	15	469
Giant,	15,394	Neat,	55	598	55	622	42	609	-	-
		2 to 1,	55	426	55	422	42	418	-	-
Iron Clad,	7,778	Neat,	34	769	84	800	14	745	-	-
		2 to 1,	34	396	84	394	14	419	-	-
Stettin-Girstow,	979	Neat,	8	665	61	714	42	709	2	629
		2 to 1,	8	370	53	340	42	382	2	378
West Kent,	3,394	Neat,	19	586	59	589	51	570	19	578
		2 to 1,	19	522	59	434	51	424	19	399
Total,	51,760	Neat,	186	721	384	707	254	680	36	620
		2 to 1,	186	395	386	389	254	396	36	421

Tabulation of Cement Tests of Cement used in the Construction of the Wachusett Dam during the Year 1901.

BRAND.	Number of Barrels used.	Composition of Briquette.	FINENESS.			WIRE TESTS.		TENSILE STRENGTH.							
								ONE DAY.		SEVEN DAYS.		TWENTY-EIGHT DAYS.		THREE MONTHS.	
			Per Cent. Residue on No. 50 Sieve, 2,500 Meshes to Square Inch.	Per Cent. Residue on No. 100 Sieve, 10,000 Meshes to Square Inch.	Per Cent. Residue on No. 180 Sieve, 32,400 Meshes to Square Inch.	Minutes to bear Light Wire.	Minutes to bear Heavy Wire.	Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.
Giant (Portland), ...	17,703	Neat, . .	.6	10.5	24.6	102	327	1,687	635	1,684	828	1,649	896	60	894
		2 to 1, . .	-	-	-	-	316	-	-	1,693	890	1,648	440	60	406
Union (natural), ...	8,892	Neat, . .	.9	5.8	13.5	33	74	964	183	962	234	983	306	25	379
		1 to 1, . .	-	-	-	26	56	-	-	958	203	983	298	25	452

Tabulation of Cement Tests for All Brands of Natural and Portland Cement used in Construction of the Weston Aqueduct during 1901.

BRAND.	Number of Barrels used.	Composition of Briquette.	FINENESS.			WIRE TESTS.		TENSILE STRENGTH.									
								ONE DAY.		SEVEN DAYS.		TWENTY-EIGHT DAYS.		THREE MONTHS.		SIX MONTHS.	
			Per Cent. Residue on No. 50 Sieve, 2,500 Meshes to Square Inch.	Per Cent. Residue on No. 100 Sieve, 10,000 Meshes to Square Inch.	Per Cent. Residue on No. 180 Sieve, 32,400 Meshes to Square Inch.	Minutes to bear Light Wire.	Minutes to bear Heavy Wire.	Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.	Number of Briquettes.	Pounds per Square Inch.
Natural cements:—																	
Hoffman, ...	20,400	Neat, .	2.6	12.3	-	25	60	1,564	166	1,566	188	437	267	115	363	-	-
		1 to 1, .	-	-	-	28	71	-	-	1,492	145	433	230	113	368	-	-
Union, ...	6,258	Neat, .	0.9	6.2	12.8	45	88	451	187	454	235	182	295	3	379	-	-
		1 to 1, .	-	-	-	37	88	-	-	446	207	195	284	5	415	-	-
Totals, ...	26,658	Neat, .	2.2	10.8	-	30	67	2,015	171	2,020	199	619	276	118	363	-	-
		1 to 1, .	-	-	-	30	76	-	-	1,938	160	628	247	118	370	-	-
Portland cements:—																	
Atlas, ...	11,430	Neat, .	0.2	8.4	18.6	74	263	890	572	900	757	397	795	57	859	4	949
		2 to 1, .	-	-	-	-	206	-	-	860	292	396	379	43	429	10	537
Giant, ...	2,380	Neat, .	0.2	9.6	20.4	64	290	172	496	177	685	83	754	5	975	-	-
		2 to 1, .	-	-	-	-	286	-	-	167	296	86	375	-	-	-	-
Totals, ...	13,810	Neat, .	0.2	8.6	18.9	72	268	1,062	559	1,077	745	480	788	62	868	4	949
		2 to 1, .	-	-	-	-	220	-	-	1,027	293	482	379	43	429	10	537

APPENDIX NO. 3.

TABLE NO. 1. — *Monthly Rainfall in Inches at Various Places on the Metropolitan Water Works, in 1901.*

PLACE.		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Nashua watershed.	Princeton,	1.63	0.98	5.30	9.84	6.85	1.03	5.56	4.78	3.22	3.77	2.47	9.46	54.89
	Jefferson,	1.91	1.39	6.02	9.44	7.33	2.25	5.55	4.92	2.98	3.96	2.32	9.35	57.87
	Sterling,	1.52	0.96	5.79	10.03	6.86	1.65	5.51	3.99	2.90	3.34	2.07	8.84	53.46
	Boylston,*	1.93	1.20	6.18	9.25	7.05	1.13	6.03	4.62	3.34	3.72	2.84	9.80	57.09
Sudbury watershed.	Sudbury Dam,	1.81	1.35	6.34	8.19	7.74	1.37	5.08	4.10	2.91	3.04	2.70	8.29	52.92
	Framingham,	1.86	1.49	6.41	8.00	7.01	1.20	5.19	4.42	2.96	2.57	2.72	10.87	54.70
	Ashland Dam,	1.97	1.74	6.73	8.34	6.72	1.39	6.37	4.82	3.62	2.62	2.91	10.30	57.53
	Cordaville,	1.65	1.51	6.80	9.87	7.43	1.56	6.19	4.93	3.73	3.04	3.26	9.31	59.28
Lake Cochituate,		1.85	1.80	6.35	7.51	6.93	1.26	6.67	4.48	3.17	2.83	3.08	8.53	54.46
Chestnut Hill Reservoir,		1.72	0.77	7.25	8.21	7.14	1.23	6.40	4.15	3.25	3.01	2.83	8.25	54.21
Spot Pond,		1.73	0.82	6.83	8.36	7.19	1.86	4.69	3.64	3.67	2.54	2.78	7.96	52.07
Average of all,		1.78	1.27	6.36	8.82	7.12	1.45	5.75	4.44	3.25	3.13	2.72	9.18	55.27
Average, Nashua watershed,		1.75	1.13	5.82	9.64	7.02	1.51	5.66	4.58	3.10	3.70	2.43	9.36	55.70
Average, Sudbury watershed,		1.82	1.52	6.57	8.60	7.23	1.38	5.71	4.57	3.30	2.82	2.90	9.69	56.11

* The rainfall station at Boylston has been substituted for that at South Clinton, of which the records have been given in former reports.

TABLE No. 2. — *Rainfall in Inches at Jefferson, Mass., in 1901.*

DAY OF MONTH.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1,	-	-	-	-	-	-	-	-	0.71†	-	0.11†	-
2,	-	-	0.05†	-	*	-	0.08†	-	-	0.75†	-	-
3,	-	-	-	*	0.40†	-	-	0.18†	-	-	-	*
4,	-	*	0.30†	*	-	0.07†	-	0.10†	-	-	-	2.90‖
5,	-	1.15‡	0.40‡	2.41§	-	-	0.07†	-	-	-	-	-
6,	-	-	-	*	-	-	*	*	-	0.14†	-	-
7,	-	-	-	*	-	0.85†	0.55†	1.75†	-	-	-	-
8,	-	-	-	*	-	-	-	-	-	-	-	-
9,	0.12†	-	0.20‡	*	-	-	0.23†	-	-	-	-	-
10,	*	-	*	2.66†	*	-	-	-	*	-	-	0.77†
11,	*	-	2.25†	-	1.00†	-	*	-	0.41†	-	*	-
12,	1.12‖	-	-	-	0.24†	-	0.75†	0.06†	0.22†	*	0.70‖	-
13,	-	-	*	-	-	-	-	-	-	*	-	-
14,	*	-	*	-	-	-	-	-	-	*	0.07‡	*
15,	*	-	*	-	-	-	-	-	0.85†	2.90†	-	1.75†
16,	*	*	0.25‡	0.14†	-	-	-	-	-	-	-	-
17,	0.08‡	0.09‡	-	-	-	-	0.90†	*	*	*	-	*
18,	-	-	-	-	*	-	-	0.30†	*	0.13§	-	0.11‡
19,	-	-	-	-	*	-	-	0.18†	0.30†	0.04§	0.10‡	-
20,	*	-	-	*	1.85†	-	-	*	-	-	-	-
21,	0.05†	-	1.35†	*	-	*	-	0.15†	-	-	-	-
22,	-	0.07‡	-	*	0.14†	1.03†	0.06†	-	-	-	-	-
23,	*	*	-	*	-	0.30†	-	-	-	-	-	*
24,	0.20¶	0.08‡	0.17†	*	*	-	-	*	-	-	*	0.65‖
25,	-	-	-	3.90†	1.60†	-	1.10†	2.25†	-	-	1.30§	0.05†
26,	-	-	*	-	-	-	-	-	-	-	0.04‡	*
27,	*	-	1.05†	-	*	-	-	-	-	-	-	0.87‡
28,	0.04‡	-	-	-	*	-	*	-	-	-	-	*
29,	-	-	-	-	*	-	1.81†	-	*	-	-	*
30,	*	-	-	0.33†	2.10†	-	-	-	0.44†	-	-	2.25†
31,	0.30‡	-	-	-	-	-	-	-	-	-	-	-
Totals,	1.91	1.39	6.02	9.44	7.33	2.25	5.55	4.92	2.93	3.96	2.32	9.35

Total for the year, 57.37 inches.

* Rainfall included in that of following day. † Rain. ‡ Snow.
§ Rain and snow. ‖ Rain, snow and hail. ¶ Snow and hail.

TABLE No. 3. — *Rainfall in Inches at Framingham, Mass., in 1901.*

DAY OF MONTH.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1, ...	-	-	-	-	-	0.04†	-	-	0.24†	-	0.04†	-
2, ...	-	-	0.13†	0.02†	0.70†	-	0.26†	-	0.02†	*	-	*
3, ...	-	-	0.20†	*	-	-	-	0.03†	0.12†	0.51†	-	1.77§
4, ...	-	*	*	*	-	-	-	0.06†	-	-	-	-
5, ...	-	1.35‡	0.35§	1.93†	-	-	0.19†	-	-	0.09†	-	-
6, ...	-	-	-	*	-	-	0.21†	*	-	0.05†	-	-
7, ...	-	-	-	*	-	*	0.02†	1.34†	-	-	-	-
8, ...	0.02†	-	*	*	-	0.42†	-	-	-	-	-	-
9, ...	-	-	0.33†	*	-	-	0.21†	-	-	-	-	-
10, ...	0.50§	-	*	2.50†	*	-	-	-	*	-	-	1.09†
11, ...	*	-	2.26†	-	1.32†	-	1.29†	0.06†	0.69†	-	*	-
12, ...	0.75§	0.02‡	-	-	-	-	-	0.02†	0.11†	-	0.35§	*
13, ...	-	-	-	-	0.27†	-	-	0.02†	0.06†	0.02†	-	0.12†
14, ...	*	-	0.12¶	-	-	-	-	-	-	*	-	*
15, ...	*	-	0.01‡	*	-	-	-	0.03†	0.62†	1.85†	-	3.02†
16, ...	0.14§	0.01‡	-	0.55†	-	-	-	-	-	-	-	-
17, ...	0.10‡	-	-	-	-	-	0.42†	*	0.28†	0.05†	-	*
18, ...	-	-	-	-	*	-	-	0.44†	*	-	*	0.12‡
19, ...	-	-	-	-	*	-	-	0.06†	0.24†	-	0.21‡	0.02‡
20, ...	-	-	*	*	2.47†	-	-	-	0.06†	-	-	-
21, ...	0.01†	-	1.02†	*	-	0.05†	0.03†	-	-	-	-	-
22, ...	-	-	-	*	0.13†	0.63†	-	-	-	-	-	-
23, ...	*	*	-	*	-	0.04†	-	-	-	-	0.02‡	*
24, ...	0.12†	0.11‡	0.27†	*	*	0.02†	*	*	-	-	*	1.00†
25, ...	-	-	-	2.74†	0.74†	-	1.00†	2.36†	-	-	2.08†	0.02†
26, ...	-	-	*	-	*	-	0.02†	-	-	-	0.02‡	*
27, ...	-	-	1.72†	-	*	-	-	-	-	-	-	0.91§
28, ...	-	-	-	-	*	-	*	-	-	-	-	-
29, ...	-	-	-	-	*	-	1.54†	-	0.52†	-	-	*
30, ...	*	-	-	0.26†	1.37†	-	-	-	-	-	-	2.80†
31, ...	0.22‡	-	-	-	0.01†	-	-	-	-	-	-	-
Totals, ...	1.86	1.49	6.41	8.00	7.01	1.20	5.19	4.42	2.96	2.57	2.72	10.87

Total for the year, 54.70 inches.

* Rainfall included in that of following day. † Rain. ‡ Snow.
§ Rain and snow. ¶ Snow and hail.

TABLE No. 4. — *Rainfall at Chestnut Hill Reservoir in 1901.*

DATE.	Inches.	Rain or Snow.	Duration.	
Jan. 10,	0.53	Snow.	1.15 P.M. to	
Jan. 11,				1.30 A.M.
Jan. 11,	0.75	Rain and snow.	1.30 P.M. to	
Jan. 12,				3.15 P.M.
Jan. 15,	0.09	Snow and rain.	4.30 A.M. to	3.00 P.M.
Jan. 17,	0.10	Snow.	6.30 P.M. to	
Jan. 18,				2.00 A.M.
Jan. 30,	0.25	Snow.	8.15 P.M. to	
Jan. 31,				10.00 P.M.
Total,	1.72			
Feb. 4,	0.60	Snow.	6.00 A.M. to	
Feb. 5,				7.00 A.M.
Feb. 23,	0.17	Snow.	11.00 P.M. to	
Feb. 24,				9.30 A.M.
Total,	0.77			
Mar. 2,	0.17	Rain.	9.00 A.M. to	2.00 P.M.
Mar. 4,	0.23	Rain.	1.45 A.M. to	4.30 A.M.
Mar. 4,	0.28	Rain and snow.	9.00 P.M. to	
Mar. 5,				8.15 A.M.
Mar. 9,	0.44	Rain.	4.00 A.M. to	
Mar. 10,				8.30 P.M.
Mar. 10,	2.25	Rain.	11.30 P.M. to	
Mar. 11,				8.30 P.M.
Mar. 14,	0.13	Rain.	1.30 A.M. to	3.00 P.M.
Mar. 20,	0.14	Rain.	6.45 P.M. to	
Mar. 21,				4.00 A.M.
Mar. 21,	1.45	Rain.	10.00 A.M. to	10.30 P.M.
Mar. 24,	0.16	Rain.	2.00 P.M. to	10.00 P.M.
Mar. 26,	2.00	Rain.	8.00 A.M. to	
Mar. 27,				1.30 A.M.
Total,	7.25			
Apr. 3,	1.67	Rain.	7.45 A.M. to	9.30 P.M.
Apr. 4,	0.16	Rain.	9.00 A.M. to	10.00 P.M.
Apr. 6,	1.89	Rain.	8.00 P.M. to	
Apr. 7,				7.30 A.M.
Apr. 8,	0.08	Mist.	During day.	
Apr. 9,	0.15	Showers.	During day.	
Apr. 10,	0.07	Showers.	During day.	
Apr. 15,	0.78	Rain.	4.15 P.M. to	
Apr. 16,				7.30 P.M.
Apr. 20,	0.57	Rain.	1.30 P.M.	
Apr. 21,			to	
Apr. 22,				
Apr. 23,				7.00 A.M.
Apr. 23,	0.02	Rain.	7.00 A.M. to	
Apr. 24,				7.00 A.M.
Apr. 24,	2.59	Rain.	7.00 A.M	
Apr. 25,			to	
Apr. 26,				7.00 A.M.
Apr. 30,	0.23	Rain.	12.15 P.M. to	11.30. P.M.
Total,	8.21			
May 2,	0.92	Rain.	2.30 P.M. to	
May 3,				3.00 A.M.
May 10,	1.03	Rain.	12.10 A.M. to	
May 11,				2.00 A.M.
May 13,	0.27	Rain.	6.10 A.M. to	9.10 A.M.
May 18,	2.68	Rain.	1.00 P.M.	
May 19,			to	
May 20,				7.00 A.M.
May 23,	0.08	Rain.	12.30 A.M. to	2.00 A.M.
May 24,	0.83	Rain.	4.40 P.M. to	
May 25,				7.15 A.M.
May 27,	0.37	Rain.	12.30 A.M. to	7.00 A.M.
May 27,	0.86	Rain.	1.15 P.M.	
May 28,			to	
May 29,				7.00 A.M.
June 1,	0.10	Rain.	2.00 A.M. to	3.00 A.M.
Total,	7.14			
June 7,	0.50	Rain.	5.35 P.M. to	
June 8,				4.30 A.M.
June 21,	0.10	Rain.	7.00 A.M. to	12.20 P.M.

TABLE No. 4. — *Rainfall at Chestnut Hill Reservoir in 1901* — Concluded.

DATE.	Inches.	Rain or Snow.	Duration.
June 22,	0.53	Rain.	7.40 A.M. to 9.40 A.M.
June 22,	0.05	Rain.	10.10 A.M. to 11.30 A.M.
June 23,			1.00 A.M. to 1.35 A.M.
June 24,	0.03	Rain.	9.15 P.M. to 11.00 P.M.
June 30,	0.02	Rain.	1.05 A.M. to 1.25 A.M.
Total,	1.23		
July 5,	0.21	Rain.	12.30 A.M. to 2.00 A.M.
July 6,	0.06	Rain.	2.00 A.M. to 4.30 A.M.
July 6,	0.32	Rain.	9.00 A.M. to 9.50 A.M.
July 6,	0.02	Shower.	During evening.
July 9,	0.11	Rain.	3.10 A.M. to 1.30 P.M.
July 11,	2.15	Rain.	4.20 P.M. to
July 12,			1.00 A.M.
July 17,	0.45	Rain.	1.10 P.M. to 3.30 P.M.
July 22,	0.03	Rain.	12.45 A.M. to 1.15 A.M.
July 25,	0.95	Rain.	1.30 A.M. to 6.15 A.M.
July 29,	2.10	Rain.	12.30 A.M. to 6.00 A.M.
Total,	6.40		
Aug. 4,	0.13	Rain.	2.15 P.M. to 9.30 P.M.
Aug. 7,	1.45	Rain.	3.30 A.M. to 2.15 P.M.
Aug. 11,	0.10	Rain.	3.05 A.M. to 3.45 A.M.
Aug. 18,	0.34	Rain.	10.15 P.M. to
Aug. 19,			3.40 A.M.
Aug. 25,	2.10	Rain.	6.30 P.M. to
Aug. 26,			12.45 A.M.
Sept. 1,	0.03	Rain.	1.15 A.M. to 7.00 A.M.
Total,	4.15		
Sept. 1,	0.37	Rain.	7.00 A.M. to 4.00 P.M.
Sept. 11,	0.67	Rain.	3.30 A.M. to 11.40 A.M.
Sept. 11,	0.10	Rain.	5.50 P.M. to 7.30 P.M.
Sept. 12,	0.15	Rain.	2.00 P.M. to 3.30 P.M.
Sept. 15,	0.29	Rain.	3.30 P.M. to 9.45 P.M.
Sept. 17,	0.45	Rain.	11.10 A.M. to 5.10 P.M.
Sept. 18,	0.35	Rain.	10.00 A.M. to
Sept. 19,			7.00 A.M.
Sept. 20,	0.16	Rain.	4.30 P.M. to 8.30 P.M.
Sept 29,	0.71	Rain.	2.00 A.M. to 11.30 P.M.
Total,	3.25		
Oct. 2,	0.48	Rain.	10.00 P.M. to
Oct. 3,			2.00 A.M.
Oct. 6,	0.12	Rain.	2.00 A.M. to 7.00 A.M.
Oct. 6,	0.01	Rain.	9.30 A.M. to 5.00 P.M.
Oct. 14,	2.36	Rain.	2.00 A.M. to 11.00 P.M.
Oct. 17,	0.04	Rain.	1.50 P.M. to 5.20 P.M.
Total,	3.01		
Nov. 11,	0.47	Snow and rain.	4.15 P.M.
Nov. 12,			to
Nov. 13,			1.30 A.M.
Nov. 19,	0.11	Snow.	1.30 A.M. to 7.15 P.M.
Nov. 24,	2.21	Rain.	3.45 A.M. to
Nov. 25,			5.30 P.M.
Nov. 26,	0.04	Snow.	4.30 A.M. to 9.30 A.M.
Total,	2.83		
Dec. 3,	1.53	Rain and snow.	3.30 A.M. to
Dec. 4,			2.00 A.M.
Dec. 9,	1.02	Rain.	10.00 P.M. to
Dec. 10,			9.20 A.M.
Dec. 10,	0.03	Rain.	10.00 A.M. to 10.45 A.M.
Dec. 13,	0.08	Rain.	6.15 P.M. to 7.30 P.M.
Dec. 14,	1.65	Rain.	9.30 P.M. to
Dec. 15,			5.30 P.M.
Dec. 17,	0.12	Snow.	10.00 A.M. to
Dec. 18,			9.30 A.M.
Dec. 24,	0.78	Rain.	2.00 A.M. to 10.30 A.M.
Dec. 26,	0.86	Snow and rain.	3.30 P.M. to
Dec. 27,			2.00 P.M.
Dec. 29,	2.18	Rain.	5.00 A.M. to
Dec. 30,			3.30 P.M.
Total,	8.25		

Total rainfall for the year, 54.21 inches.

TABLE NO. 5. — *Rainfall, in Inches, on the Sudbury Watershed,* 1875 to 1901.*

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Totals.
1875, ...	2.42	3.15	3.74	3.23	3.56	6.24	3.57	5.53	3.43	4.85	4.83	0.94	45.49
1876, ...	1.83	4.21	7.43	4.20	2.76	2.04	9.13	1.72	4.62	2.24	5.76	3.62	49.56
1877, ...	3.22	0.74	8.36	3.43	3.70	2.43	2.95	3.68	0.32	8.52	5.80	0.87	44.02
1878, ...	5.63	5.97	4.69	5.79	0.96	3.88	2.97	6.94	1.29	6.42	7.02	6.37	57.93
1879, ...	2.48	3.56	5.14	4.72	1.58	3.79	3.93	6.51	1.88	0.81	2.68	4.34	41.42
1880, ...	3.57	3.98	3.31	3.11	1.84	2.14	6.27	4.01	1.60	3.74	1.78	2.83	38.18
1881, ...	5.56	4.65	5.78	2.00	3.51	5.39	2.35	1.36	2.62	2.95	4.09	3.96	44.17
1882, ...	5.95	4.55	2.65	1.82	5.07	1.66	1.77	1.67	8.74	2.07	1.15	2.30	39.40
1883, ...	2.81	3.87	1.78	1.84	4.19	2.40	2.68	0.73	1.52	5.60	1.81	3.55	32.78
1884, ...	5.09	6.54	4.72	4.41	3.47	3.44	3.67	4.65	0.85	2.48	2.65	5.17	47.14
1885, ...	4.71	3.87	1.07	3.60	3.48	2.87	1.43	7.18	1.43	5.09	6.09	2.72	43.54
1886, ...	6.36	6.28	3.61	2.22	3.00	1.47	3.27	4.10	2.90	3.24	4.64	4.97	46.06
1887, ...	5.20	4.78	4.90	4.27	1.16	2.65	3.76	5.28	1.32	2.83	2.67	3.88	42.70
1888, ...	4.15	3.68	6.02	2.43	4.82	2.54	1.41	6.22	8.59	4.99	7.22	5.40	57.47
1889, ...	5.37	1.65	2.37	3.41	2.95	2.80	8.94	4.18	4.60	4.25	6.29	3.14	49.95
1890, ...	2.53	3.51	7.73	2.64	5.21	2.03	2.46	3.87	6.00	10.51	1.20	5.31	53.00
1891, ...	7.02	5.23	6.48	3.91	2.01	3.77	3.39	4.73	2.38	3.83	3.09	3.68	49.52
1892, ...	5.85	3.14	4.06	0.83	5.58	2.76	4.23	4.44	2.84	1.17	5.80	1.13	41.83
1893, ...	2.92	8.20	3.67	3.60	6.61	2.38	2.57	5.41	1.74	4.07	2.20	4.86	48.23
1894, ...	4.09	3.91	1.43	3.42	4.24	1.15	3.26	2.03	2.63	5.34	3.43	4.81	39.74
1895, ...	4.06	1.39	2.98	5.25	2.02	2.77	5.04	4.15	2.30	10.68	6.63	3.35	50.62
1896, ...	2.39	7.18	5.24	1.57	2.57	3.22	2.51	2.40	7.72	3.76	3.02	2.12	43.70
1897, ...	4.00	2.91	3.66	2.82	4.37	4.46	5.44	3.51	2.94	0.47	6.40	5.21	46.19
1898, ...	6.83	4.49	2.40	4.66	3.22	2.48	4.09	8.17	2.62	6.71	6.93	3.28	55.88
1899, ...	4.18	4.91	7.01	1.90	1.45	2.51	3.22	1.43	3.95	2.69	2.18	1.78	37.21
1900, ...	4.96	9.14	6.35	2.58	4.32	2.99	2.42	2.26	3.36	3.83	5.70	2.74	50.65
1901, ...	1.82	1.52	6.57	8.60	7.23	1.38	5.71	4.57	3.30	2.82	2.90	9.69	56.11
Totals, . . .	115.00	117.01	123.10	92.26	94.88	77.64	102.44	110.73	87.49	115.96	113.96	102.02	1,252.49
Averages, . . .	4.26	4.33	4.56	3.42	3.51	2.88	3.79	4.10	3.24	4.30	4.22	3.78	46.39

* Means of observations at several places, as follows: January, 1875, to April, 1876, Lake Cochituate; April to June, 1876, Lake Cochituate, Westborough and Hopkinton; June to December, 1876, Lake Cochituate, Southborough, Marlborough, Westborough and Hopkinton; December, 1876, to January, 1883, Framingham, Southborough, Marlborough, Westborough and Hopkinton; January, 1883, to January, 1884, Framingham and Southborough; January, 1884, to January, 1890, Framingham and Westborough; January, 1890, to May, 1898, Framingham and Ashland Dam; June, 1898, to December, 1901, Framingham, Ashland Dam, Cordaville and Sudbury Dam.

TABLE No. 6. — *Yield of the Sudbury Watershed in Gallons per Day per Square Mile* from 1875 to 1901.*

MONTHS.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
January, ...	103,000	643,000	658,000	1,810,000	700,000	1,120,000	415,000	1,241,000	335,000	995,000	1,235,000	1,461,000	2,589,000	1,053,000
February, ...	1,496,000	1,368,000	949,000	2,465,000	1,711,000	1,787,000	1,546,000	2,403,000	1,033,000	2,842,000	1,354,000	4,801,000	2,829,000	1,950,000
March, ...	1,604,000	4,435,000	4,814,000	3,507,000	2,330,000	1,374,000	4,004,000	2,839,000	1,611,000	3,785,000	1,572,000	2,059,000	2,868,000	3,238,000
April, ...	3,049,000	3,292,000	2,394,000	1,626,000	3,116,000	1,169,000	1,546,000	867,000	1,350,000	2,853,000	1,815,000	1,947,000	2,620,000	2,645,000
May, ...	1,188,000	1,138,000	1,391,000	1,394,000	1,114,000	514,000	965,000	1,292,000	937,000	1,030,000	1,336,000	720,000	1,009,000	1,682,000
June, ...	870,000	222,000	597,000	506,000	413,000	175,000	1,338,000	529,000	300,000	416,000	426,000	203,000	413,000	421,000
July, ...	321,000	183,000	202,000	128,000	157,000	176,000	276,000	86,000	115,000	224,000	62,000	116,000	115,000	117,000
August, ...	396,000	405,000	121,000	476,000	395,000	119,000	148,000	55,000	79,000	257,000	240,000	94,000	214,000	379,000
September, ...	207,000	184,000	60,000	161,000	141,000	80,000	197,000	307,000	91,000	44,000	121,000	117,000	111,000	1,155,000
October, ...	646,000	234,000	631,000	516,000	71,000	102,000	186,000	299,000	186,000	83,000	336,000	146,000	190,000	1,999,000
November, ...	1,302,000	1,088,000	1,418,000	1,698,000	206,000	205,000	395,000	209,000	205,000	175,000	1,177,000	673,000	369,000	2,758,000
December, ...	584,000	453,000	1,290,000	3,177,000	463,000	175,000	775,000	315,000	194,000	925,000	1,174,000	1,020,000	643,000	3,043,000
Average for year, . . .	972,000	1,135,000	1,214,000	1,452,000	894,000	578,000	979,000	862,000	533,000	1,129,000	901,000	1,087,000	1,154,000	1,697,000
Average for driest 6 months, .	574,000	384,000	502,000	532,000	230,000	143,000	330,000	211,000	145,000	200,000	391,000	223,000	234,000	953,000

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* The area of the Sudbury watershed used in making up these records included water surfaces amounting to 1.9 per cent. of the whole area from 1875 to 1878 inclusive, and subsequently increased by the construction of storage reservoirs to 3.0 per cent. in 1879, 3.4 per cent. in 1885, 3.9 per cent. in 1894 and 6.5 per cent. in 1898. The watershed also contains extensive areas of swampy land, which, though covered with water at times, are not included in the above percentages of water surfaces.

TABLE No. 6. — *Yield of the Sudbury Watershed in Gallons per Day per Square Mile * from 1875 to 1901* — Concluded.

MONTHS.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	Mean for 27 years. 1875-1901.
January,	2,782,000	1,254,000	3,018,000	1,870,000	434,000	698,000	1,034,000	1,084,000	845,000	1,638,000	2,288,000	794,000	437,000	1,205,000
February,	1,196,000	1,529,000	3,486,000	948,000	1,542,000	991,000	541,000	2,676,000	1,067,000	3,022,000	1,381,000	3,800,000	300,000	1,889,000
March,	1,338,000	3,643,000	4,453,000	1,955,000	3,245,000	2,238,000	2,410,000	3,835,000	2,565,000	2,604,000	4,205,000	3,654,000	2,755,000	2,923,000
April,	1,410,000	1,875,000	2,397,000	871,000	2,125,000	1,640,000	2,515,000	1,494,000	1,515,000	1,829,000	2,521,000	1,350,000	4,204,000	2,075,000
May,	880,000	1,366,000	583,000	1,259,000	2,883,000	840,000	636,000	360,000	915,000	1,246,000	511,000	1,312,000	2,954,000	1,163,000
June,	653,000	568,000	413,000	428,000	440,000	419,000	174,000	399,000	962,000	580,000	66,000	316,000	758,000	480,000
July,	634,000	107,000	149,000	214,000	158,000	161,000	231,000	95,000	658,000	231,000	19,000	—18,000	306,000	194,000
August,	1,432,000	132,000	163,000	280,000	181,000	209,000	229,000	57,000	591,000	1,107,000	—35,000	—34,000	424,000	301,000
September,	823,000	457,000	208,000	229,000	108,000	150,000	89,000	388,000	182,000	369,000	94,000	65,000	305,000	238,000
October,	1,230,000	2,272,000	210,000	126,000	222,000	374,000	1,379,000	592,000	94,000	1,160,000	115,000	186,000	412,000	518,000
November,	1,941,000	1,215,000	306,000	697,000	319,000	836,000	2,777,000	659,000	909,000	1,986,000	304,000	663,000	474,000	924,000
December,	2,241,000	996,000	544,000	485,000	796,000	716,000	1,782,000	657,000	1,584,000	1,799,000	220,000	1,096,000	2,695,000	1,105,000
Average for year,	1,383,000	1,285,000	1,315,000	781,000	1,037,000	770,000	1,152,000	1,019,000	991,000	1,450,000	973,000	1,082,000	1,342,000	1,061,000
Average for driest 6 months,	944,000	747,000	239,000	327,000	237,000	356,000	460,000	314,000	564,000	777,000	93,000	194,000	445,000	441,000

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* The area of the Sudbury watershed used in making up these records included water surfaces amounting to 1.9 per cent. of the whole area from 1875 to 1878 inclusive, and subsequently increased by the construction of storage reservoirs to 3.0 per cent. in 1879, 3.4 per cent. in 1885, 3.9 per cent. in 1894 and 6.5 per cent. in 1898. The watershed also contains extensive areas of swampy land, which, though covered with water at times, are not included in the above percentages of water surfaces.

TABLE No. 7. — *Sudbury River. — Statistics of Flow of Water, Storage and Rainfall in 1901.*

[Watershed from 1875 to 1878 inclusive = 77.764 square miles; in 1879 and 1880 = 78.238 square miles; and from 1881 to 1901 inclusive = 75.2 square miles.]

MONTHS.	Quantity of Water received through Wachusett Aqueduct (Gallons per Day).	Quantity of Water discharged through Sudbury Aqueduct (Gallons per Day).	Quantity of Water used by Framingham Water Company (Gallons per Day).	Quantity of Water diverted from Watershed by Sewers, etc. (Gallons per Day).	Quantity of Water wasted into River below Lowest Dam (Gallons per Day).	STORAGE. Gain (Gallons per Day).	STORAGE. Loss (Gallons per Day).	Total Flow of River (Gallons per Day).	Rainfall (Inches).	Rainfall collected (Inches).	Percentage of Rainfall collected.
January,	75,168,000	102,574,000	397,000	508,000	15,419,000	-	10,890,000	32,835,000	1.82	0.779	42.7
February,	45,657,000	100,807,000	404,000	471,000	8,186,000	-	41,672,000	22,539,000	1.52	0.483	31.7
March,	124,065,000	101,318,000	378,000	1,390,000	48,419,000	184,720,000	-	207,156,000	6.57	4.912	74.8
April,	39,277,000	82,743,000	390,000	2,607,000	228,427,000	41,230,000	-	316,120,000	8.60	7.257	84.4
May,	58,336,000	86,439,000	423,000	2,200,000	188,548,000	2,845,000	-	222,119,000	7.23	5.269	72.9
June,	75,120,000	99,143,000	517,000	978,000	38,407,000	-	7,318,000	56,607,000	1.38	1.299	94.1
July,	57,839,000	83,249,000	500,000	281,000	3,419,000	-	7 113,000	22,997,000	5.71	0.545	9.6
August,	59,687,000	76,632,000	458,000	419,000	23,497,000	-	9,471,000	31,848,000	4.57	0.756	16.5
September,	41,627,000	71,447,000	480,000	437,000	20,420,000	-	28,190,000	22,967,000	3.30	0.527	16.0
October,	48,674,000	82,048,000	478,000	390,000	22,148,000	-	25,445,000	30,945,000	2.82	0.734	26.1
November,	54,850,000	93,970,000	468,000	368,000	37,940,000	-	42,223,000	35,663,000	2.90	0.819	28.3
December,	87,890,000	104,129,000	474,000	1,381,000	120,193,000	64,381,000	-	202,668,000	9.69	4.808	49.6
Totals,	-	-	-	-	-	-	-	-	56.11	28.188	-
Average for year,	64,248,000	90,828,000	447,000	954,000	62,742,000	10,707,000	-	100,930,000	-	-	50.2

TABLE No. 8. — *Lake Cochituate. — Statistics of Flow of Water, Storage and Rainfall in 1901.*

[Watershed of lake = 18.87 square miles.*]

MONTHS.	Quantity of Water received through Sudbury Aqueduct (Gallons per Day).	Quantity of Water discharged through Cochituate Aqueduct (Gallons per Day).	Quantity of Water diverted from Snake Brook† (Gallons per Day).	Quantity of Water diverted from Watershed by Sewers, etc. (Gallons per Day).	Quantity of Water wasted at Outlet (Gallons per Day).	STORAGE.		Quantity of Water collected in Lake (Gallons per Day).	Rainfall (Inches).	Rainfall collected (Inches).	Percentage of Rainfall collected.
						Gain (Gallons per Day).	Loss (Gallons per Day)				
January, . . .	7,535,000	14,739,000	-	526,000	-	2,509,000	-	10,239,000	1.85	0.968	52.3
February, . .	-	14,564,000	-	397,000	-	-	7,293,000	7,668,000	1.80	0.655	36.4
March, . . .	5,339,000	16,536,000	-	906,000	-	34,794,000	-	46,897,000	6.35	4.434	69.8
April, . . .	4,817,000	15,633,000	-	1,933,000	20,344,000	23,600,000	-	56,693,000	7.51	5.187	69.1
May, . . .	-	3,825,000	-	1,710,000	39,055,000	584,000	-	45,174,000	6.93	4.269	61.6
June, . . .	-	6,660,000	-	870,000	6,363,000	-	1,466,000	12,427,000	1.26	1.137	90.2
July, . . .	-	19,442,000	-	429,000	-	-	10,210,000	9,661,000	6.67	0.913	13.7
August, . . .	-	23,800,000	-	436,000	-	-	10,810,000	13,426,000	4.48	1.269	28.3
September, . .	-	23,693,000	1,923,000	420,000	-	-	13,693,000	12,343,000	3.17	1.129	35.6
October, . .	-	21,500,000	2,003,000	391,000	-	-	10,684,000	13,210,000	2.83	1.249	44.1
November, . .	-	10,670,000	1,603,000	340,000	-	-	-	12,613,000	3.03	1.154	38.1
December, . .	-	7,490,000	5,694,000	1,029,000	4,839,000	25,771,000	-	44,823,000	8.58	4.237	49.4
Totals, . . .	-	-	-	-	-	-	-	-	54.46	26.601	-
Average for year,	1,489,000	14,890,000	944,000	784,000	5,928,000	2,847,000	-	23,899,000	-	-	48.8

* Not including the watershed of Dudley Pond.

† On account of work in progress at Snake Brook Meadow.

TABLE NO. 9. — *Nashua River. — Statistics of Flow of Water, Storage and Rainfall, July, 1896, to December, 1901, inclusive.**

[Watershed = 119.00 square miles.]

MONTHS.	Quantity of Water discharged through Wachusett Aqueduct (Million Gallons per Day).†	Quantity of Water wasted into River (Million Gallons per Day).	STORAGE.‡ Gain (Million Gallons per Day).	STORAGE.‡ Loss (Million Gallons per Day).	Total Flow of River (Million Gallons per Day).	Rainfall (Inches).	Rainfall collected (Inches).	Percentage of Rainfall collected.
1896.								
July,	-	39.941	-	-	39.941	4.74	0.599	12.6
August,	-	35.959	-	-	35.959	2.62	0.539	20.6
September,	-	54.340	-	-	54.340	7.31	0.788	10.8
October,	-	94.451	-	-	94.451	3.72	1.415	38.1
November,	-	108.442	-	-	108.442	2.99	1.572	52.6
December,	-	111.265	-	-	111.265	2.22	1.668	74.9
Totals,	-	-	-	-	-	23.60	6.581	-
Average, 6 months,	-	73.987	-	-	73.987	-	-	27.9
1897.								
January,	-	94.736	-	-	94.736	3.46	1.420	41.0
February,	-	110.742	-	-	110.742	2.86	1.500	52.5
March,	-	328.480	-	-	328.480	4.01	4.922	122.9
April,	-	194.189	-	-	194.189	2.32	2.818	121.5
May,	-	144.442	-	6.000	138.442	5.06	2.075	41.0
June,	-	143.657	-	3.100	140.557	5.11	2.089	39.9
July,	-	169.008	2.613	-	171.621	8.65	2.572	29.7
August,	-	116.027	-	9.387	106.640	3.47	1.599	46.1
September,	-	57.404	-	12.200	45.204	1.93	0.656	33.9
October,	-	38.964	-	10.000	28.964	0.94	0.434	46.2
November,	-	125.030	27.600	-	152.630	7.62	2.214	29.0
December,	-	261.362	9.419	-	270.781	6.41	4.059	63.3
Totals,	-	-	-	-	-	51.84	26.808	-
Average for year,	-	149.186	-	0.123	149.063	-	-	50.7
1898.								
January,	-	184.640	1.323	-	185.963	6.65	2.787	41.9
February,	-	194.609	-	-	194.609	3.30	2.635	79.8
March,	87.148	280.381	-	-	367.529	2.27	5.509	242.7
April,	99.210	142.046	-	-	241.256	4.43	3.500	79.0
May,	53.423	119.545	-	7.548	165.420	3.38	2.480	73.4
June,	47.437	62.926	-	11.843	98.520	3.11	1.429	46.0
July,	24.629	21.132	-	6.193	39.568	3.01	0.593	19.7
August,	0.006	149.807	7.806	-	157.619	10.61	2.363	22.3
September,	53.880	30.436	-	3.933	80.383	3.15	1.166	37.0
October,	14.844	154.456	10.226	-	179.526	7.21	2.691	37.3
November,	12.927	243.703	1.633	-	258.263	6.81	3.746	55.0
December,	89.803	154.607	0.839	-	245.249	3.99	3.676	92.2
Totals,	-	-	-	-	-	57.92	32.575	-
Average for year,	40.464	144.723	-	0.615	184.572	-	-	56.2

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* The gagings of the Nashua River (South Branch) at Clinton are here published for the first time. Attention is called to a description of the method of gaging, given on page 94.

† Including small quantities wasted in cleaning aqueduct.

‡ In ponds and mill reservoirs.

TABLE No. 9. — *Nashua River. — Statistics of Flow of Water, Storage and Rainfall, July, 1896, to December, 1901, inclusive* — Concluded.

[Watershed = 119.00 square miles.]

MONTHS.	Quantity of Water discharged through Wachusett Aqueduct (Million Gallons per Day).*	Quantity of Water wasted into River (Million Gallons per Day).	Storage.† Gain (Million Gallons per Day).	Storage.† Loss. (Million Gallons per Day).	Total Flow of River (Million Gallons per Day).	Rainfall (Inches).	Rainfall collected (Inches).	Percentage of Rainfall collected.
1899.								
January,	117.136	131.500	0.290	-	248.926	2.93	3.731	127.2
February,	98.193	31.561	-	-	129.754	5.12	1.757	34.3
March,	104.500	226.106	-	0.258	330.348	6.75	4.952	73.4
April,	86.643	316.297	-	1.133	401.807	1.94	5.829	300.8
May,	80.819	28.045	-	6.290	102.574	1.33	1.538	115.6
June,	63.233	3.764	-	0.200	66.797	5.51	0.969	17.6
July,	44.807	3.145	-	5.839	42.113	3.82	0.631	16.5
August,	28.952	3.219	-	4.097	28.074	3.20	0.421	13.2
September,	29.507	2.663	-	2.433	29.737	4.11	0.431	10.5
October,	24.848	2.652	1.677	-	29.177	2.72	0.437	16.1
November,	42.920	2.780	5.467	-	51.167	1.94	0.742	38.3
December,	37.345	2.449	2.908	-	42.697	2.03	0.640	31.5
Totals,	-	-	-	-	-	41.40	22.078	-
Average for year,	63.039	62.903	-	0.847	125.095	-	-	53.3
1900.								
January,	63.894	11.980	18.903	-	94.777	4.56	1.420	31.1
February,	81.635	390.025	10.822	-	482.482	8.69	6.532	75.2
March,	100.100	342.858	-	-	442.958	6.19	6.639	107.3
April,	83.237	104.756	-	-	187.993	2.76	2.727	98.8
May,	61.803	109.000	-	6.322	164.481	4.34	2.467	56.8
June,	64.003	15.047	-	10.300	68.750	3.59	0.998	27.8
July,	35.042	3.213	-	12.387	25.868	3.20	0.388	12.1
August,	27.297	3.268	-	7.162	23.403	3.18	0.351	11.0
September,	15.637	3.166	-	3.633	15.170	3.46	0.220	6.4
October,	27.981	3.687	1.935	-	33.603	2.90	0.504	17.4
November,	59.230	26.643	18.267	-	104.140	6.44	1.510	23.4
December,	107.081	71.093	8.678	-	186.852	3.15	2.800	88.9
Totals,	-	-	-	-	-	52.46	26.556	-
Average for year,	60.461	88.512	1.496	-	150.469	-	-	50.6
1901.								
January,	75.168	4.448	-	17.871	61.745	1.75	0.926	52.9
February,	45.657	4.222	-	7.500	42.379	1.13	0.574	50.8
March,	124.065	165.164	34.258	-	323.487	5.82	4.849	83.3
April,	39.894	551.773	1.500	-	593.167	9.64	8.605	89.3
May,	58.336	267.939	-	1.523	324.752	7.02	4.867	69.3
June,	75.120	50.470	-	8.333	117.257	1.51	1.701	112.8
July,	57.339	7.235	-	7.839	56.735	5.66	0.851	15.0
August,	59.687	6.413	-	5.194	60.906	4.58	0.913	19.9
September,	41.627	4.943	-	8.500	38.070	3.10	0.552	17.8
October,	48.674	20.203	8.129	-	77.006	3.70	1.154	31.2
November,	54.850	5.136	1.467	-	61.453	2.43	0.892	36.7
December,	87.890	275.171	21.710	-	384.771	9.36	5.766	61.6
Totals,	-	-	-	-	-	55.70	31.650	-
Average for year,	64.299	114.058	0.972	-	179.329	-	-	56.8

* Including small quantities wasted in cleaning aqueduct. † In ponds and mill reservoirs.

Table No. 10. — *Yield of the Nashua River (South Branch) in Gallons per Day per Square Mile* from 1897 to 1901.*

MONTHS.	1897.	1898.	1899.	1900.	1901.	Mean for 5 Years, 1897-1901.
January,	796,000	1,563,000	2,092,000	796,000	519,000	1,153,000
February,	981,000	1,635,000	1,090,000	4,054,000	356,000	1,615,000
March,	2,760,000	3,088,000	2,776,000	3,722,000	2,718,000	3,014,000
April,	1,632,000	2,027,000	3,376,000	1,580,000	4,986,000	2,720,000
May,	1,163,000	1,390,000	862,000	1,382,000	2,729,000	1,506,000
June,	1,181,000	828,000	561,000	578,000	985,000	827,000
July,	1,442,000	838,000	354,000	217,000	477,000	565,000
August,	896,000	1,325,000	236,000	197,000	512,000	633,000
September,	380,000	676,000	250,000	127,000	320,000	351,000
October,	243,000	1,509,000	245,000	282,000	647,000	585,000
November,	1,283,000	2,170,000	430,000	375,000	517,000	1,055,000
December,	2,275,000	2,061,000	359,000	1,570,000	3,234,000	1,900,000
Average for year,	1,253,000	1,551,000	1,051,000	1,264,000	1,507,000	1,325,000
Average for driest 6 months,	336,000	1,013,000	312,000	377,000	576,000	668,000

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* The area of the watershed used in making up these records includes water surfaces amounting to 2.2 per cent. of the whole area.

TABLE No. 11.—*Elevations of Water Surfaces of Reservoirs above Boston City Base at the Beginning of each Month.*

DATES.	Chestnut Hill Reservoir.	Lake Cochituate.	Dudley Pond.	Farm Pond.	Spot Pond.	FRAMINGHAM RESERVOIR.			Ashland Reservoir.	Sudbury Reservoir.	Hopkinton Reservoir.	Whitehall Reservoir.
						No. 1.	No. 2.	No. 3.				
	Ordinary High Water =134 00.	High Water =144 36.	High Water =156.46.	High Water =159.25.	High Water =163 00.	Flash Boards 169.27.	Flash Boards 177.12.	Flash Boards 186.50.	Flash Boards 225.28.	Flash Boards 259.97.	Flash Boards 305.00.	High Water =337.91.
Jan. 1, 1901, .	133.93	136.38	152.32	158.85	159.47	167.76	176.01	183.53	214.44	252.54	291.99	334.82
Feb. 1, 1901, .	133.87	136.83	152.44	158.83	159.49	167.68	175.94	183.58	216.23	251.01	293.32	335.20
March 1, 1901, .	132.25	135.62	152.39	158.74	159.52	167.53	171.95	183.45	217.10	247.23	294.08	335.40
April 1, 1901, .	133.97	141.25	153.15	159.39	161.90	167.99	176.80	183.78	225.22	258.62	304.74	337.29
May 1, 1901, .	134.21	144.28	154.21	160.05	163.22	168.33	176.92	186.74	224.67	260.02	305.00	339.16
June 1, 1901, .	133.76	144.35	155.03	159.87	162.96	168.25	176.94	186.88	225.09	260.16	305.18	339.14
July 1, 1901, .	134.54	144.18	154.84	159.57	163.17	169.17	177.86	184.64	225.31	259.98	305.26	338.91
Aug. 1, 1901, .	132.50	142.89	154.64	159.39	163.30	169.42	177.94	184.35	225.39	259.40	305.38	339.05
Sept. 1, 1901, .	131.97	141.39	154.36	159.30	163.09	169.46	177.22	184.25	225.34	258.83	305.27	339.03
Oct. 1, 1901, .	132.02 132.03	139.44	153.94	159.08	161.60	169.41	177.18	184.28	225.31	256.86	305.10	338.97
Nov. 1, 1901, .	131.91 131.93	137.78	153.61	158.89	162.33	169.42	177.19	184.11	225.31	254.90	305.04	339.08
Dec. 1, 1901, .	133.41 133.45	137.73	153.51	158.92	162.95	167.82	176.08	184.20	224.36	252.75	304.04	338.04
Jan. 1, 1902, .	133.89 133.93	141.65	154.29	159.43	163.78	168.39	176.53	183.86	224.90	257.35	304.89	338.30

NOTE.— Where two elevations are given for Chestnut Hill Reservoir, the first refers to Bradlee Basin and the second to Lawrence Basin.

Table No. 12. — *Times when the Sudbury and Cochituate Aqueducts have been in Service, and the Sources from which the Supply for the Sudbury Aqueduct has been drawn.*

Sudbury Aqueduct: —

From 7.00 A.M. Jan. 1 to 9.45 A.M. Feb. 18, from Framingham Reservoir No. 3.
From 9.45 A.M. Feb. 18 to 2.20 P.M. Mar. 8, from Framingham Reservoirs Nos. 2 and 3.
From 2.20 P.M. Mar. 8 to 11.00 A.M. Mar. 12, from Framingham Reservoirs Nos. 1, 2 and 3.
From 11.00 A.M. Mar. 12 to 11.30 A.M. Mar. 14, from Framingham Reservoirs Nos. 1 and 3.
From 11.30 A.M. Mar. 14 to 11.35 A.M. Mar. 23, from Framingham Reservoirs Nos. 1, 2 and 3.
From 11.35 A.M. Mar. 23 to 12.00 P.M. Apr. 11, from Framingham Reservoir No. 3.
From 6.00 P.M. Apr. 12 to 10.30 P.M. Apr. 17, from Framingham Reservoir No. 3.
From 4.30 P.M. Apr. 18 to 8.30 P.M. Apr. 24, from Framingham Reservoir No. 3.
From 3.00 P.M. Apr. 25 to 8.30 P.M. May 1, from Framingham Reservoir No. 3.
From 3.00 P.M. May 2 to 11.00 A.M. June 13, from Framingham Reservoir No. 3.
From 11.00 A.M. June 13 to 9.30 A.M. July 9, from Framingham Reservoirs Nos. 2 and 3.
From 9.30 A.M. July 9 to 7.00 A.M. July 26, from Framingham Reservoirs Nos. 1, 2 and 3.
From 7.00 A.M. July 26 to 10.40 A.M. Aug. 3, from Framingham Reservoirs Nos. 2 and 3.
From 10.40 A.M. Aug. 3 to 7.00 A.M. Jan. 1, 1902, from Framingham Reservoir No. 3.

Cochituate Aqueduct: —

From 7.00 A.M. Jan. 1 to 3.00 P.M. May 7.
From 5.15 P.M. June 11 to 7.00 A.M. Nov. 18.
From 12.00 M. Dec. 3 to 7.00 P.M. Dec. 6.
From 1.00 P.M. Dec. 9 to 12.00 M. Dec. 13.
From 3.00 P.M. Dec. 16 to 11.00 A.M. Dec. 21.
From 10.00 A.M. Dec. 22 to 10.00 A.M. Dec. 26.
From 1.00 P.M. Dec. 26 to 9.00 A.M. Dec. 30.
From 10.00 A.M. Dec. 31 to 7.00 A.M. Jan. 1, 1902.

TABLE No. 13. — *Average Daily Quantity of Water flowing through Aqueducts in 1901, by Months.*

MONTHS.	Wachusett Aqueduct (Gallons).	SUDBURY AQUEDUCT.			Cochituate Aqueduct (Gallons).
		From Framingham Reservoir No. 3 (Gallons).	From Framingham Reservoirs Nos. 1 and 2 (Gallons).	Total (Gallons).	
January, . .	75,168,000	102,574,000	-	102,574,000	14,739,000
February, . .	45,657,000	92,378,000	8,429,000	100,807,000	14,564,000
March, . . .	124,065,000	66,542,000	34,771,000	101,313,000	16,536,000
April, . . .	39,894,000	82,637,000	106,000	82,743,000	15,633,000
May, . . .	58,336,000	86,342,000	97,000	86,439,000	3,825,000
June, . . .	75,120,000	91,866,000	7,277,000	99,143,000	6,660,000
July, . . .	57,339,000	69,673,000	13,576,000	83,249,000	19,442,000
August, . . .	59,687,000	76,284,000	348,000	76,632,000	23,800,000
September, . .	41,627,000	71,447,000	-	71,447,000	23,693,000
October, . .	48,674,000	82,048,000	-	82,048,000	21,500,000
November, . .	54,850,000	93,970,000	-	93,970,000	10,670,000
December, . .	87,890,000	104,129,000	-	104,129,000	7,490,000
Averages, .	64,299,000	84,930,000	5,398,000	90,328,000	14,890,000

NOTE. — Slight discrepancies between the figures for flow in the Wachusett Aqueduct in this table and those in Table No. 7 are due to taking account of quantities wasted in cleaning the aqueduct which were not discharged into Sudbury Reservoir.

The Wachusett Aqueduct discharges into Sudbury Reservoir, whence the water flows into Framingham Reservoir No. 3. Of the total quantity flowing through the Sudbury Aqueduct, an average of 1,489,000 gallons per day flowed into Lake Cochituate, leaving an average of 88,839,000 gallons per day, which, with the exception of a small quantity wasted in cleaning the aqueduct, was discharged into Chestnut Hill Reservoir.

TABLE No. 14. — *Statement of Operations of Engines Nos. 1 and 2 at Chestnut Hill High-service Pumping Station for the Year 1901.*

[These engines were designed for the high service, but were used for low service, except as noted.]

MONTHS.	ENGINE No. 1.		ENGINE No. 2.										
	Total Pumping Time.	Amount pumped, 4.28 Per Cent. allowed for Slip (Million Gallons).	Total Pumping Time.	Amount pumped, 4.28 Per Cent. allowed for Slip (Million Gallons).	Total Amount pumped (Million Gallons).	Amount of Coal consumed (Pounds).	Coal consumed by Reserve Boiler, which also furnished Steam for Electric Lighting Plant (Pounds).	Amount of Ashes and Clinkers (Pounds).	Per Cent. of Ashes and Clinkers.	Quantity pumped per Pound of Coal, no Deduction for Heating or Lighting (Gallons).	Average Lift (Feet).	Duty in Foot-pounds per 100 Pounds of Coal, no Deduction for Heating or Lighting, 4.28 Per Cent. allowed for Slip.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement, no Deduction for Heating or Lighting.
	Hrs. Min.		Hrs. Min.										
January,	-	-	-	-	-	-	-	-	-	-	-	-	-
February,	-	-	-	-	-	-	-	-	-	-	-	-	-
March (high service),	29 40	11.65	-	-	11.65	26,227	-	1,595	6.0	444.20	125.28	46,860,000	48,400,000
April,	25 35	10.63	-	-	10.63	22,087	26,057	2,509	11.4	481.28	45.86	18,390,000	19,200,000
May,	28 05	11.83	-	-	11.83	17,827	63,410	998	11.6	663.60	52.55	29,050,000	30,330,000
June,	153 00	62.05	2 20	0.94	62.99	53,787	23,123	4,153	7.7	1,171.10	52.28	51,000,000	53,250,000
July (high service),	166 20	71.72	-	-	71.72	107,207	28,855	9,732	9.1	668.99	126.40	70,440,000	73,550,000
August (high service),	41 05	17.35	-	-	17.35	20,181	39,889	1,920	9.5	859.72	124.56	89,200,000	93,130,000
September (high service),	4 10	1.77	7 45	2.54	4.31	10,029	27,378	1,020	10.2	429.75	124.24	44,480,000	46,440,000
September,	54 35	23.69	1 10	0.46	24.15	21,527	-	1,775	8.2	1,121.85	46.06	48,040,000	49,940,000
October,	224 50	94.91	-	-	94.91	74,628	7,023	6,718	9.0	1,271.77	45.60	48,310,000	50,440,000
November (high service),	22 45	8.87	-	-	8.87	17,940	50,125	1,590	8.9	494.43	124.67	51,850,000	58,610,000
December (high service),	176 00	72.33	42 40	16.24	88.57	151,352	25,573	13,079	8.6	585.19	122.45	59,690,000	62,320,000
Totals and averages, high service,	440 00	183.69	49 85	18.78	202.47	332,936	166,820	28,936	8.7	608.13	124.33	62,980,000	65,760,000
Totals and averages, low service,	486 05	203.11	3 30	1.40	204.51	189,856	120,213	16,153	8.5	1,077.18	48.13	43,190,000	45,090,000

TABLE No. 15. — *Statement of Operations of Engine No. 3 at Chestnut Hill High-service Pumping Station for the Year 1901.*

[This engine was designed for the high service, but was used for low service, except as noted.]

MONTHS.	Total Pumping Time.	Amount pumped, 3.03 Per Cent. allowed for Slip (Million Gallons).	Amount of Coal consumed (Pounds).	Coal consumed by Reserve Boiler, which also furnished Steam for Electric Lighting Plant (Pounds).	Amount of Ashes and Clinkers (Pounds).	Per Cent. of Ashes and Clinkers.	Quantity pumped per Pound of Coal, no Deduction for Heating or Lighting (Gallons).	Average Lift (Feet).	Duty in Foot-pounds per 100 Pounds of Coal, no Deduction for Heating or Lighting, 3.03 Per Cent. allowed for Slip.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement, no Deduction for Heating or Lighting.
	Hrs. Min.									
January (high service),	9 30	9.21	10,045	325	850	8.5	916.87	136.14	103,980,000	107,220,000
January,	151 35	141.35	100,920	23,513	10,053	10.0	1,400.61	65.04	75,880,000	78,250,000
February,	-	-	-	-	-	-	-	-	-	-
March (high service),	175 15	178.57	176,381	5,275	16,831	9.5	1,012.41	126.12	106,360,000	109,680,000
March,	165 30	158.77	109,035	-	11,957	11.0	1,456.14	71.81	87,100,000	89,820,000
April,	180 15	161.60	107,775	7,764	13,152	12.2	1,499.42	67.59	84,420,000	87,050,000
May,	3 50	3.91	*-	-	-	-	-	40.53	-	-
June,	204 50	178.95	115,729	14,218	13,818	11.9	1,546.28	67.13	86,460,000	89,160,000
July (high service),	353 40	349.64	312,731	16,785	33,767	10.8	1,118.02	125.06	116,470,000	120,100,000
July,	1 00	1.00	3,055	-	230	7.5	327.33	67.70	18,460,000	19,040,000
August (high service),	77 45	75.96	66,653	-	6,721	13.6	1,139.63	125.30	118,950,000	122,660,000
September,	-	-	-	-	-	-	-	-	-	-
October,	-	-	-	-	-	-	-	-	-	-
November (high service),	43 55	49.81	46,446	3,486	4,378	9.4	1,072.37	125.97	112,530,000	116,040,000
December (high service),	353 30	353.38	309,901	5,460	31,617	10.2	1,140.30	124.61	118,360,000	122,050,000
Totals and averages, high service,	1,013 35	1,016.57	922,157	31,331	94,164	10.2	1,102.38	125.25	115,010,000	118,600,000
Totals and averages, low service,	707 00	645.58	436,514	45,495	49,210	11.3	1,478.94	67.77	83,490,000	86,090,000

* Coal used charged to Engine No. 4.

TABLE No. 16.—*Statement of Operations of Engine No. 4, at Chestnut Hill High-service Pumping Station for the Year 1901.*

MONTHS.	Total Pumping Time.		Amount pumped, 1.47 Per Cent. allowed for Slip (Million Gallons).	Amount of Coal consumed (Pounds).	Amount of Ashes and Clinkers (Pounds).	Per Cent. of Ashes and Clinkers.	Quantity pumped per Pound of Coal, no Deduction for Heating or Lighting (Gallons).	Average Lift (Feet).	Duty in Foot-pounds per 100 Pounds of Coal, no Deduction for Heating or Lighting, 1.47 Per Cent. allowed for Slip.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement, no Deduction for Heating or Lighting.	Summary of Engines Nos. 1, 2, 3 and 4.	
											Total Amount pumped, Allowance made for Slip (Million Gallons).	Daily Average Amount pumped (Million Gallons).
	Hrs.	Min.										
January,	734	25	825.17	594,251	58,743	9.9	1,388.58	125.26	144,890,000	147,060,000	975.78	31.475
February,	672	00	758.21	586,627	55,706	9.5	1,292.49	126.18	135,850,000	137,890,000	758.21	27.079
March,	571	05	611.54	453,082	40,446	8.9	1,349.73	126.14	141,820,000	143,950,000	960.53	30.985
April,	719	15	753.96	563,250	56,693	10.1	1,338.59	124.96	139,340,000	141,430,000	926.19	30.873
May,	740	30	792.35	592,084	59,265	10.0	1,338.24	125.30	139,680,000	141,780,000	808.09	26.067
June,	743	30	822.05	615,387	59,667	9.7	1,335.83	126.43	140,680,000	142,790,000	1,063.99	35.466
July,	386	50	447.68	333,514	31,389	9.4	1,342.31	126.95	141,950,000	144,060,000	870.04	28.066
August,	665	50	735.65	529,801	50,457	9.5	1,388.54	126.92	146,800,000	149,000,000	828.96	26.741
September,	718	10	804.50	590,070	56,121	9.5	1,363.40	126.91	144,180,000	146,290,000	832.96	27.765
October,	744	00	834.74	619,188	55,274	8.9	1,348.12	127.16	142,800,000	144,940,000	929.65	29.989
November,	671	00	747.87	533,777	46,975	8.8	1,401.09	126.08	147,150,000	149,360,000	806.55	26.885
December,	384	45	450.39	335,030	30,618	9.1	1,344.33	128.66	144,080,000	146,240,000	892.34	28.785
Totals and averages,	7,751	20	8,584.11	6,346,061	601,354	9.5	1,352.67	126.31	142,320,000	144,450,000	10,663.24	29.187

TABLE No. 17. — *Statement of Operations of Engines Nos. 5, 6 and 7 at Chestnut Hill Low-service Pumping Station for the Year 1901.*

MONTHS.	ENGINE No. 5.		ENGINE No. 6.		ENGINE No. 7.		Total Amount pumped (Million Gallons).	Daily Average Amount pumped (Million Gallons).	Total Amount of Coal consumed (Pounds).	Per Cent. of Ashes and Clinkers.	Quantity pumped per Pound of Coal, no Deduction for Heating or Lighting (Gallons).	AVERAGE LIFT (Feet).			Duty in Foot-pounds per 100 Pounds of Coal, no Deduction for Heating or Lighting, 1.53 Per Cent. allowed for Slip.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement, no Deduction for Heating or Lighting.
	Total Pumping Time.	Amount pumped, 1.53 Per Cent. allowed for Slip (Million Gallons).	Total Pumping Time.	Amount pumped, 1.53 Per Cent. allowed for Slip (Million Gallons).	Total Pumping Time.	Amount pumped, 1.53 Per Cent. allowed for Slip (Million Gallons).						Engine No. 5.	Engine No. 6.	Engine No. 7.		
	Hrs. Min.		Hrs. Min.		Hrs. Min.											
January, ...	691 05	785.99	734 15	829.31	568 40	643.19	2,258.49	72.855	718,235	9.0	3,144.50	47.32	47.17	27.95	109,360,000	111,060,000
February, ...	669 50	817.27	672 00	819.26	666 55	795.60	2,432.13	86.862	774,221	9.1	3,141.39	53.65	53.50	23.80	114,710,000	116,490,000
March, ...	743 15	862.91	579 15	661.76	744 00	827.68	2,352.35	75.882	745,331	9.1	3,156.11	55.77	55.10	23.18	115,980,000	117,780,000
April, ...	444 41	595.89	507 20	660.69	517 20	648.42	1,905.00	63.500	556,870	9.6	3,420.91	47.72	44.32	25.74	111,300,000	113,030,000
May, ...	523 55	657.11	641 45	814.35	361 40	485.53	1,956.99	63.129	535,427	9.3	3,655.01	41.40	43.10	47.05	132,470,000	134,520,000
June, ...	243 35	331.86	718 05	979.34	478 55	656.01	1,967.21	65.574	653,793	8.9	3,008.92	47.63	52.99	55.25	132,440,000	134,490,000
July, ...	660 55	838.00	562 45	706.14	613 55	777.61	2,321.75	74.895	795,331	8.5	2,919.22	56.40	56.48	57.44	138,050,000	140,190,000
August, ...	561 35	774.24	436 45	598.13	614 50	845.07	2,217.44	71.530	734,416	8.6	3,019.32	54.24	55.10	53.20	136,010,000	138,120,000
September, ...	534 35	740.74	194 45	258.22	709 35	966.66	1,965.62	65.521	596,610	9.4	3,294.65	46.60	46.96	45.03	125,900,000	127,850,000
October, ...	744 00	1,055.64	338 05	469.77	504 35	708.73	2,234.14	72.069	787,198	8.5	2,838.08	53.08	56.44	52.93	127,050,000	129,020,000
November, ...	347 25	447.86	663 40	921.46	605 05	832.53	2,201.85	73.395	761,477	8.4	2,891.55	56.52	51.82	53.06	128,250,000	130,240,000
December, ...	736 55	887.31	713 35	854.82	675 20	799.30	2,541.43	81.982	869,761	8.5	2,921.99	50.30	50.09	49.82	121,890,000	123,780,000
Totals and averages,	6,901 46	8,794.82	6,762 15	8,573.25	7,060 50	8,986.83	26,354.40	72.204	8,528,670	8.9	3,090.09	51.21	51.06	43.01	124,490,000	126,420,000

TABLE No. 18. — *Statement of Operations of Engine No. 8 at Spot Pond Pumping Station for the Year 1901.*

MONTHS.	Total Pumping Time.	Amount pumped, 2.02 Per Cent. allowed for Slip (Million Gallons).	Amount of Coal consumed (Pounds).	Amount of Ashes and Clinkers (Pounds).	Per Cent. of Ashes and Clinkers.	Quantity pumped per Pound of Coal, no Deduction for Heating or Lighting (Gallons).	Average Lift (Feet).	Duty in Foot-pounds per 100 Pounds of Coal, no Deduction for Heating or Lighting, 2.02 Per Cent. allowed for Slip.	Duty in Foot-pounds per 100 Pounds of Coal, on Basis of Plunger Displacement, no Deduction for Heating or Lighting.
	Hrs. Min.								
January,	-	-	-	-	-	-	-	-	-
February,	61 20	26.67	29,542	2,597	8.8	902.78	115.77	87,060,000	88,850,000
March,	-	-	-	-	-	-	-	-	-
April,	-	-	-	-	-	-	-	-	-
May,	184 00	79.67	85,959	9,036	10.5	926.84	112.68	87,000,000	88,790,000
June,	-	-	-	-	-	-	-	-	-
July,	-	-	-	-	-	-	-	-	-
August,	-	-	-	-	-	-	-	-	-
September,	367 50	161.55	148,638	16,173	10.9	1,086.87	114.63	103,780,000	105,920,000
October,	190 40	84.00	80,836	7,720	9.6	1,039.14	115.74	100,190,000	102,250,000
November,	-	-	-	-	-	-	-	-	-
December,	-	-	-	-	-	-	-	-	-
Totals and averages,	803 50	351.89	344,975	35,526	10.3	1,020.04	114.54	97,320,000	99,320,000

TABLE No. 19. — *Statement of Operations of Engine No. 9 at Spot Pond Pumping Station for the Year 1901.*

MONTHS.	Total Pumping Time.		Amount pumped. 1.63 Per Cent. allowed for Slip (Million Gallons.)	Amount of Coal consumed (Pounds).	Amount of Ashes and Clinkers (Pounds).	Per Cent. of Ashes and Clinkers.	Quantity pumped per Pound of Coal, no Deduction for Heating or Lighting (Gallons).	Average Lift (Feet).	Duty in Foot-pounds per 100 Pounds of Coal, no Deduction for Heating or Lighting, 1.63 Per Cent. allowed for Slip.	Duty in Foot-pounds per 100 Pounds of Coal on Basis of Plunger Displacement, no Deduction for Heating or Lighting.
	Hrs.	Min.								
January,	239	05	198.76	217,834	25,258	11.6	912.44	121.84	92,610,000	94,150,000
February,	204	50	171.12	170,639	15,154	8.9	1,002.82	121.87	101,800,000	103,490,000
March,	249	00	206.25	194,600	18,026	9.3	1,059.87	120.90	106,740,000	108,510,000
April,	208	25	175.36	160,567	14,811	9.2	1,092.13	116.39	105,890,000	107,650,000
May,	181	30	150.88	129,276	11,933	9.2	1,167.12	118.74	115,440,000	117,360,000
June,	318	45	262.37	212,950	21,630	10.2	1,232.07	118.98	122,110,000	124,140,000
July,	346	20	292.00	222,765	20,124	9.0	1,310.80	119.06	130,000,000	132,160,000
August,	321	05	263.15	215,279	20,272	9.4	1,222.37	119.65	121,830,000	123,850,000
September,	89	15	74.03	56,475	5,712	10.1	1,310.85	120.50	131,580,000	133,760,000
October,	180	00	149.41	117,029	10,848	9.3	1,276.69	120.83	128,500,000	130,630,000
November,	270	35	221.67	166,585	16,680	10.0	1,330.67	119.02	131,930,000	134,120,000
December,	401	25	249.53	212,022	18,677	8.8	1,176.91	117.70	115,390,000	117,310,000
Totals and averages,	3,010	15	2,414.53	2,076,021	199,125	9.6	1,163.06	119.50	115,780,000	117,700,000

Table No. 20. — *Average Daily Consumption of Water in Cities and Towns in the Metropolitan Water District and the Town of Swampscott, supplied wholly or in Part by the Metropolitan Water Works (1901).*

MONTHS.	Supplied by Metropolitan Works (Million Gallons).	Supplied from Local Sources (Million Gallons).*	Total (Million Gallons).	Estimated Population.	Consumption per Inhabitant (Gallons).
January,	107.930	.631	108.561	834,200	130
February,	113.967	.723	114.690	836,200	137
March,	101.509	1.218	102.722	838,200	123
April,	90.010	.561	90.571	840,200	108
May,	91.844	.566	92.410	842,200	110
June,	98.932	.672	99.604	844,000	118
July,	102.410	.782	103.192	845,900	122
August,	98.581	.700	99.281	847,700	117
September,	98.088	.726	98.814	849,500	116
October,	99.645	.481	100.126	851,800	118
November,	98.336	-	98.336	853,200	115
December,	110.277	-	110.277	855,000	129
For the year,	100.904	.588	101.492	844,800	120

* The town of Stoneham was supplied by the Wakefield Water Company until October 21, and a portion of the supply of the city of Medford was taken from Wright's Pond from February 25 to March 27.

Table No. 21. — *Average Daily Consumption of Water from the Low Service (1901).*

MONTHS.	Southern Low-service of Boston, excluding East Boston and Charlestown (Million Gallons).	Somerville, Chelsea, Everett, Malden, Medford, Charlestown, East Boston, Melrose and Arlington.			Total Low-service Consumption (Million Gallons).
		Supplied from Metropolitan Sources (Million Gallons).	Gravity Supply to Medford from Wright's Pond (Million Gallons).	Total Northern Low-service Consumption (Million Gallons).	
January,	43.649	30.588	-	30.588	74.237
February,	46.017	33.372	.099	33.471	79.488
March,	41.946	26.751	.594	27.345	69.291
April,	38.460	20.238	-	20.238	58.698
May,	36.581	21.717	-	21.717	58.298
June,	37.434	25.694	-	25.694	63.128
July,	36.852	27.568	-	27.568	64.420
August,	37.104	25.881	-	25.881	62.985
September,	37.322	25.780	-	25.780	63.102
October,	38.580	26.276	-	26.276	64.856
November,	38.527	25.472	-	25.472	63.999
December,	44.947	28.373	-	28.373	73.320
For the year,	39.754	26.443	.058	26.501	66.255

TABLE No. 22. — *Average Daily Consumption of Water from the Southern High Service (1901).*

MONTHS.	Pumped at Chestnut Hill High-service Station for the Supply of Boston, Quincy, Watertown and Belmont (Million Gallons).*	MONTHS.	Pumped at Chestnut Hill High-service Station for the Supply of Boston, Quincy, Watertown and Belmont (Million Gallons).*
January, ...	26.577	August, ...	26.456
February, ...	26.646	September, ...	26.479
March, ...	25.438	October, ...	26.655
April, ...	24.751	November, ...	26.382
May, ...	25.253	December, ...	28.460
June, ...	27.018	For the year, . . .	26.496
July, ...	27.806		

* This does not include water pumped from southern high-service mains for southern extra high-service, at the West Roxbury pumping station.

TABLE No. 23. — *Average Daily Consumption of Water, in Million Gallons, from the Northern High Service, supplying Revere, Winthrop, Swampscott, Nahant, Stoneham and Breed's Island, and the Higher Portions of Chelsea, Everett, Malden, Medford, Melrose and Somerville (1901).*

MONTHS.	Pumped by Wakefield Water Co. for Stoneham.	Pumped at East Boston Station.	Pumped at Spot Pond Station.	Total Northern High-service Pumpage.	Storage in Fells Reservoir.	Total Northern High-service Consumption.
January, ...	.631	.055	6.411	7.097	+.062	7.159
February, ...	.624	.070	7.064	7.758	+.073	7.831
March, ...	.619	.060	6.653	7.332	—.024	7.308
April, ...	.561	.058	5.846	6.465	+.044	6.509
May, ...	.566	.053	7.437	8.056	+.215	8.271
June, ...	.672	.037	8.746	9.455	—.760	8.695
July, ...	.782	-	9.419	10.201	—.041	10.160
August, ...	.700	-	8.488	9.188	+.001	9.189
September, ...	.726	-	7.852	8.578	+.025	8.603
October, ...	.481	-	7.529	8.010	+.010	8.020
November, ...	-	-	7.389	7.389	+.019	7.408
December, ...	-	-	8.049	8.049	—.084	7.965
For the year, ...	.580	.027	7.579	8.186	—.088	8.098

Stoneham connected with Metropolitan Water Works mains October 21, at 10.15 A.M. Pumping at East Boston station discontinued June 20, at 8.30 P.M.

TABLE No. 24. — *Average Daily Consumption of Water from the Southern Extra High Service in West Roxbury and the Northern Extra High Service in Arlington (1901).*

MONTHS.	Southern Extra High Service, West Roxbury (Gallons).	Northern Extra High Service, Arlington (Gallons).
January,	325,000	263,000
February,	433,000	292,000
March,	430,000	260,000
April,	381,000	232,000
May,	319,000	269,000
June,	383,000	379,000
July,	381,000	426,000
August,	284,000	367,000
September,	296,000	334,000
October,	272,000	323,000
November,	258,000	289,000
December,	261,000	271,000
For the year,	334,000	309,000

TABLE No. 25. — *Consumption of Water in the Metropolitan Water District, as constituted December 31, 1901, and the Town of Swampscott, 1893–1901.*

[Gallons per Day.]

MONTHS.	1893.	1894.	1895.	1896.	1897.
January,	74,997,000	67,282,000	68,780,000	82,677,000	85,143,000
February,	71,638,000	68,699,000	80,119,000	86,750,000	88,695,000
March,	67,410,000	62,460,000	69,296,000	85,359,000	82,486,000
April,	62,048,000	57,432,000	62,636,000	77,229,000	79,639,000
May,	60,743,000	60,338,000	64,886,000	73,026,000	76,451,000
June,	63,025,000	67,981,000	69,511,000	77,218,000	77,567,000
July,	68,939,000	73,241,000	69,265,000	79,563,000	85,104,000
August,	66,619,000	67,632,000	71,319,000	78,188,000	88,725,000
September,	64,315,000	66,796,000	73,339,000	73,824,000	88,906,000
October,	63,443,000	62,423,000	66,707,000	71,423,000	79,202,000
November,	60,900,000	61,949,000	64,596,000	71,641,000	72,471,000
December,	66,454,000	64,856,000	70,200,000	79,199,000	76,844,000
Average for the year,	65,867,000	65,078,000	69,188,000	78,032,000	80,474,000
Population,	714,623	734,512	754,401	776,947	799,493
Consumption per inhabitant,	92.2	88.6	91.7	100.4	100.7

TABLE No. 25 — *Concluded.*

MONTHS.	1898.	1899.	1900.	1901.
January,	83,628,000	96,200,000	99,806,000	111,008,000
February,	87,211,000	103,204,000	98,684,000	117,172,000
March,	85,172,000	89,920,000	97,474,000	105,187,000
April,	76,269,000	86,185,000	89,145,000	92,968,000
May,	76,304,000	89,041,000	87,483,000	95,212,000
June,	83,024,000	97,237,000	98,059,000	102,857,000
July,	87,762,000	96,393,000	107,186,000	106,256,000
August,	87,096,000	91,662,000	102,153,000	102,116,000
September,	87,862,000	91,092,000	103,088,000	101,467,000
October,	81,452,000	89,264,000	97,958,000	102,856,000
November,	77,898,000	86,432,000	93,302,000	100,867,000
December,	86,073,000	85,558,000	97,539,000	112,829,000
Average for the year,	83,803,000	91,773,000	97,659,000	104,179,000
Population,	822,039	844,585	867,181	890,700
Consumption per inhabitant,	101.3	108.7	112.6	117.0

TABLE No. 26. — *Consumption of Water in the Metropolitan Water District and Swampscott, 1890–1901.*

YEAR.	Water Consumption (Gallons per Day).	Population.	Consumption per Inhabitant (Gallons per Day).
1890,	47,824,000	654,957	73.0
1891,	52,947,000	674,846	78.5
1892,	57,987,000	694,735	83.5
1893,	65,867,000	714,623	92.2
1894,	65,078,000	734,512	88.6
1895,	69,188,000	754,401	91.7
1896,	78,032,000	776,947	100.4
1897,	80,474,000	799,493	100.7
1898,	83,803,000	822,039	101.3
1899,	91,773,000	844,585	108.7
1900,	97,659,000	867,131	112.6
1901,	104,185,000	890,700	117.0

Increase in decade from 1891 to 1901: —

In population,	32 per cent.
In consumption per inhabitant,	49 per cent.
In total consumption,	97 per cent.

Note relating to Chemical Examinations of Water, Tables Nos. 27–33.

The chemical examinations contained in the tables were made by the State Board of Health. Colors have been determined by the Nessler standard, but the corresponding values by the platinum standard are also given, for the purpose of comparison with colors determined in the laboratory of the Metropolitan Water and Sewerage Board, as given in subsequent tables. The odor recorded is taken in such a way that it is a much stronger odor than would be noticed in samples drawn directly from a tap or collected directly from a reservoir. In nearly all cases the samples are collected and examined monthly; in the case of the Sudbury Reservoir, however, they are made weekly.

TABLE NO. 27. — *Chemical Examinations of Water from the Nashua River above the Temporary Dam at Clinton.*

[Parts per 100,000.]

Number.	Date of Collection.	APPEARANCE.				ODOR.		RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	COLOR.		Cold.	Hot.	Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
				Nessler Standard.	Transformed to Platinum Standard.						Total.	Dissolved.	Suspended.					
	1901.																	
34287	Jan. 1	V. slight.	V. slight.	.33	.35	Distinctly vegetable.	Decidedly vegetable.	3.45	1.25	.0016	.0148	.0136	.0012	.24	.0100	.0000	.49	1.4
34654	Feb. 4	V. slight.	V. slight.	.24	.29	Distinctly vegetable.	Distinctly vegetable and musty.	3.50	1.10	.0006	.0190	.0138	.0052	.24	.0130	.0001	.34	1.1
34971	March 4	Decided.	Cons.	.25	.29	None.	Faintly unpleasant.	4.05	1.25	.0038	.0202	.0146	.0056	.30	.0130	.0001	.34	1.1
35296	April 1	Slight.	Slight.	.32	.34	None.	Faintly vegetable.	2.90	1.15	.0004	.0166	.0152	.0014	.16	.0100	.0000	.52	0.6
35553	April 29	Slight.	Slight.	.36	.37	None.	Distinctly vegetable.	2.65	1.25	.0014	.0150	.0126	.0024	.16	.0060	.0000	.42	0.5
35828	June 3	Slight.	Slight.	.50	.46	Distinctly vegetable.	Distinctly vegetable.	3.05	1.20	.0006	.0142	.0112	.0030	.12	.0070	.0000	.56	0.8
36195	July 1	Slight.	Slight.	.33	.35	Faintly vegetable.	Distinctly vegetable.	3.75	1.45	.0020	.0204	.0170	.0034	.24	.0050	.0007	.32	1.4
36647	Aug. 5	Slight.	Slight.	.50	.46	None.	Faintly vegetable.	3.70	1.80	.0026	.0212	.0168	.0044	.19	.0010	.0001	.52	1.4
37076	Sept. 3	Slight.	Cons.	.33	.35	Faintly vegetable.	Distinctly vegetable.	4.50	1.80	.0030	.0172	.0168	.0004	.19	.0040	.0002	.57	1.3
37418	Sept. 30	Slight.	Slight.	.29	.32	Faintly vegetable.	Distinctly vegetable.	4.30	1.40	.0014	.0234	.0192	.0042	.25	.0050	.0002	.41	1.6
37828	Nov. 4	Decided.	Slight.	.34	.35	Distinctly vegetable.	Decidedly vegetable.	4.30	1.60	.0020	.0208	.0172	.0036	.27	.0040	.0001	.46	1.3
38124	Dec. 2	V. slight.	Slight.	.43	.41	Distinctly vegetable.	Decidedly vegetable.	4.80	2.00	.0010	.0164	.0146	.0018	.30	.0060	.0001	.53	1.1
Av.	....	....	....	.35	.36	....	....	3.75	1.44	.0017	.0183	.0152	.0031	.22	.0070	.0001	.46	1.1

TABLE No. 28. — *Chemical Examinations of Water from Framingham Reservoir No. 3.*

[Parts per 100,000.]

Number.	Date of Collection.	APPEARANCE.				ODOR.		RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Oxygen Consumed.	Hardness.
				COLOR.							ALBUMINOID.							
		Turbidity.	Sediment.	Nessler Standard.	Transformed to Platinum Standard.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1901.																	
34276	Jan. 1	None.	Slight.	.35	.36	None.	Faintly vegetable.	4.35	1.80	.0030	.0182	.0136	.0046	.26	.0190	.0000	.61	1.7
34651	Feb. 4	V. slight.	V. slight.	.31	.34	Faintly vegetable.	Faintly vegetable.	4.40	1.70	.0020	.0150	.0140	.0010	.23	.0220	.0000	.48	2.0
34960	March 4	V. slight.	Slight.	.28	.32	None.	Faintly vegetable.	4.70	1.65	.0024	.0144	.0128	.0016	.32	.0240	.0001	.48	2.0
35295	April 1	Slight.	Slight.	.30	.33	None.	Faintly vegetable.	4.15	1.65	.0036	.0180	.0136	.0044	.24	.0280	.0000	.41	1.1
35536	April 29	Slight.	Slight.	.26	.30	Faintly vegetable	Faintly unpleasant and fishy.	3.50	1.25	.0020	.0162	.0142	.0020	.22	.0160	.0000	.32	1.1
35823	June 3	Slight.	Slight.	.30	.33	None.	Faintly vegetable.	3.75	1.25	.0024	.0146	.0140	.0006	.27	.0310	.0002	.48	1.6
36186	July 1	V. slight.	V. slight.	.22	.27	Faintly vegetable.	Distinctly vegetable.	4.80	1.70	.0012	.0160	.0154	.0006	.26	.0210	.0005	.36	1.4
36637	Aug. 5	None.	Slight, cyclops.	.20	.26	Distinctly vegetable.	Decidedly vegetable.	4.20	1.65	.0022	.0150	.0132	.0018	.24	.0110	.0002	.37	1.6
37048	Sept. 3	V. slight.	Slight.	.12	.20	Faintly vegetable.	Distinctly vegetable.	5.40	1.35	.0024	.0174	.0130	.0044	.27	.0050	.0001	.35	1.7
37408	Sept. 30	V. slight.	Slight.	.18	.24	Faintly vegetable.	Distinctly vegetable.	4.00	1.80	.0008	.0162	.0134	.0028	.22	.0040	.0001	.36	1.7
37815	Nov. 4	V. slight.	V. slight	.11	.19	Faintly vegetable.	Distinctly vegetable.	3.75	1.50	.0014	.0192	.0180	.0012	.22	.0020	.0000	.38	1.4
38165	Dec. 2	Slight.	Slight.	.26	.30	Faintly vegetable.	Distinctly vegetable.	6.90	2.10	.0020	.0170	.0152	.0018	.28	.0040	.0000	.45	1.3
Av...	....	....	....	.24	.29	....	....	4.49	1.57	.0021	.0164	.0142	.0022	.25	.0156	.0001	.42	1.5

TABLE No. 29. — *Chemical Examinations of Water from Lake Cochituate.*

[Parts per 100,000.]

Number.	Date of Collection.	APPEARANCE.				ODOR.		RESIDUE ON EVAPORATION		AMMONIA.				Chlorine.	NITROGEN AS		Oxygen Consumed.	Hardness.
				COLOR.							ALBUMINOID.							
		Turbidity.	Sediment.	Nessler Standard.	Transformed to Platinum Standard.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1901.																	
34283	Jan. 1	V. slight.	Slight.	.20	.26	Distinctly vegetable.	Decidedly vegetable.	4.60	1.10	.0102	.0218	.0184	.0034	.43	.0060	.0004	.40	2.1
34652	Feb. 4	V. slight.	Slight, cyclops.	.24	.29	Faintly vegetable.	Distinctly vegetable.	5.10	1.60	.0054	.0202	.0180	.0022	.45	.0090	.0001	.40	2.0
34961	March 4	V. slight.	V. slight.	.22	.27	Faintly vegetable.	Distinctly vegetable.	5.10	1.40	.0022	.0208	.0188	.0020	.49	.0100	.0002	.44	2.2
35294	April 1	V. slight.	Slight.	.21	.27	None.	Faintly vegetable.	4.70	1.70	.0034	.0208	.0174	.0034	.39	.0200	.0001	.40	2.1
35543	April 29	Slight.	Cons.	.25	.29	Faintly vegetable.	Distinctly vegetable.	5.00	1.75	.0048	.0282	.0234	.0048	.48	.0200	.0002	.50	1.8
35825	June 3	Slight.	Cons.	.42	.40	Faintly vegetable.	Distinctly vegetable.	4.90	1.75	.0032	.0258	.0212	.0046	.42	.0170	.0004	.62	2.2
36193	July 1	Slight.	Cons.	.34	.35	None.	None.	5.40	2.15	.0088	.0296	.0240	.0056	.47	.0110	.0005	.55	2.1
36636	Aug. 5	None.	V. slight, cyclops.	.28	.32	None.	Faintly vegetable.	4.85	1.95	.0018	.0254	.0216	.0038	.39	.0100	.0004	.57	2.1
37063	Sept. 3	Slight.	Cons.	.25	.29	Faintly vegetable.	Distinctly vegetable.	6.90	2.50	.0014	.0244	.0196	.0048	.31	.0030	.0002	.57	2.3
37427	Sept. 30	V. slight.	Slight, cyclops.	.24	.29	Faintly vegetable.	Distinctly vegetable.	5.35	2.55	.0010	.0246	.0210	.0036	.32	.0040	.0001	.48	2.2
37820	Nov. 4	V. slight.	Sl't, cons. cyclops.	.20	.26	Distinctly vegetable.	Decidedly vegetable.	5.10	1.90	.0024	.0230	.0184	.0046	.39	.0060	.0000	.40	2.1
38198	Dec. 2	V. slight.	V. slight.	.24	.29	Distinctly vegetable.	Decidedly vegetable.	5.10	2.00	.0064	.0218	.0176	.0042	.43	.0070	.0008	.38	2.1
Av.	....	....	....	.26	.30	....	....	5.17	1.86	.0042	.0239	.0200	.0039	.41	.0102	.0002	.48	2.1

TABLE NO. 30. — *Chemical Examinations of Water from Spot Pond, Stoneham.*

[Parts per 100,000.]

Number.	Date of Collection.	APPEARANCE.				ODOR.		RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Oxygen Consumed.	Hardness.
		Turbidity.	Sediment.	COLOR.		Cold.	Hot.	Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
				Nessler Standard.	Transformed to Platinum Standard.						Total.	Dissolved.	Suspended.					
	1901.																	
34264	Jan. 1	V. slight.	Slight, cyclops.	.07	.13	None.	None.	5.25	1.35	.0032	.0234	.0192	.0042	.34	.0040	.0000	.35	2.2
34642	Feb. 4	None.	V. slight.	.08	.15	Faintly vegetable.	Faintly vegetable.	5.35	1.45	.0008	.0158	.0128	.0030	.30	.0050	.0000	.33	2.0
34947	March 4	V. slight.	Slight.	.12	.20	Faintly unpleasant.	Distinctly unpleasant.	5.60	1.45	.0016	.0212	.0192	.0020	.34	.0040	.0001	.35	2.1
35285	April 1	V. slight.	Cons.	.10	.18	Faintly unpleasant.	Decidedly unpleasant and fishy.	4.75	1.25	.0012	.0180	.0144	.0036	.28	.0080	.0001	.35	2.3
35597	May 6	Slight.	Cons.	.11	.19	Distinctly vegetable.	Distinctly unpleasant and fishy.	4.55	1.35	.0008	.0156	.0126	.0030	.28	.0050	.0001	.30	2.1
35889	June 10	V. slight.	Slight.	.06	.11	None.	None.	4.30	1.20	.0034	.0174	.0148	.0026	.30	.0050	.0001	.25	2.0
36251	July 8	V. slight.	V. slight.	.06	.11	None.	None.	4.50	1.45	.0000	.0154	.0138	.0016	.27	.0030	.0001	.27	1.8
36634	Aug. 5	None.	Slight.	.06	.11	None.	Faintly vegetable.	4.75	1.85	.0008	.0152	.0122	.0030	.28	.0040	.0002	.30	2.1
37117	Sept. 9	None.	V. slight.	.08	.15	Distinctly vegetable.	Distinctly vegetable.	4.60	1.60	.0006	.0136	.0130	.0006	.24	.0050	.0001	.31	2.0
37414	Sept. 30	V. slight.	Slight.	.08	.15	Faintly vegetable.	Distinctly vegetable.	4.50	1.80	.0010	.0168	.0130	.0038	.25	.0050	.0001	.29	2.3
37819	Nov. 4	V. slight.	V. slight.	.08	.15	Faintly vegetable.	Faintly fishy.	4.15	1.55	.0030	.0178	.0160	.0018	.24	.0020	.0000	.31	1.8
38201	Dec. 3	V. slight.	Cons.	.08	.15	Distinctly unpleasant.	Decidedly unpleasant, distinctly fishy.	4.45	1.75	.0006	.0154	.0140	.0014	.29	.0000	.0001	.30	1.7
Av...	....	....	....	.08	.15	....	....	4.73	1.50	.0014	.0171	.0146	.0025	.28	.0042	.0001	.31	2.0

TABLE No. 31. — *Chemical Examinations of Water from a Faucet at the State House, Boston.*

[Parts per 100,000.]

Number.	Date of Collection.	APPEARANCE.				ODOR.		RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Oxygen Consumed.	Hardness.
				COLOR.							ALBUMINOID.							
		Turbidity.	Sediment.	Nessler Standard.	Transformed to Platinum Standard.	Cold.	Hot.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
	1901.																	
34265	Jan. 1	V. slight.	Slight.	.32	.34	Distinctly vegetable.	Decidedly vegetable.	4.65	1.40	.0026	.0168	.0142	.0026	.32	.0080	.0001	.47	1.8
34640	Feb. 4	V slight.	V. slight.	.30	.33	Distinctly vegetable.	Distinctly vegetable.	4.60	1.75	.0016	.0132	.0116	.0016	.35	.0270	.0000	.44	1.6
34968	March 5	V. slight.	Slight.	.30	.33	Faintly vegetable.	Distinctly vegetable.	4.85	1.45	.0010	.0158	.0146	.0012	.36	.0230	.0002	.48	1.7
35282	April 1	V. slight.	Slight.	.30	.33	Faintly vegetable.	Distinctly vegetable.	3.90	1.30	.0030	.0152	.0138	.0014	.28	.0290	.0000	.42	1.4
35528	April 29	V. slight.	Slight.	.22	.27	Faintly vegetable.	Distinctly vegetable.	4.00	1.35	.0018	.0142	.0136	.0006	.30	.0300	.0002	.34	1.4
35807	June 3	Slight.	Cons.	.25	.29	None.	Faintly vegetable.	3.85	1.60	.0006	.0156	.0124	.0032	.26	.0370	.0000	.36	1.7
36234	July 5	None.	Slight.	.29	.32	None.	Faintly vegetable.	4.55	1.60	.0010	.0160	.0156	.0004	.27	.0140	.0000	.45	1.7
36629	Aug. 5	None.	Slight.	.24	.29	None.	Distinctly vegetable.	4.65	2.10	.0004	.0140	.0132	.0008	.29	.0090	.0002	.44	2.3
37069	Sept. 4	V. slight.	Slight.	.20	.26	Faintly vegetable.	Distinctly vegetable.	4.90	2.00	.0006	.0182	.0166	.0016	.28	.0050	.0002	.41	1.8
37409	Sept. 30	V. slight.	Slight.	.14	.21	None.	Faintly vegetable.	4.50	1.90	.0000	.0168	.0154	.0014	.32	.0080	.0001	.39	1.7
37842	Nov. 5	V. slight.	V. slight.	.14	.21	Faintly vegetable.	Distinctly vegetable.	4.20	1.65	.0020	.0190	.0168	.0022	.30	.0080	.0000	.43	1.8
38181	Dec. 2	V. slight.	V. slight.	.22	.27	Distinctly vegetable.	Decidedly vegetable.	4.50	1.60	.0006	.0144	.0130	.0014	.31	.0100	.0000	.44	1.4
Av. …	………	………	………	.24	.29	………	………	4.43	1.64	.0013	.0158	.0142	.0016	.30	.0173	.0001	.42	1.7

TABLE No. 32. — *Averages of Examinations of Water from Various Parts of the Metropolitan Water Works. — 1901.*

[Parts per 100,000.]

LOCALITY.	COLOR.		RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Oxygen Consumed.	Hardness.
	Nessler Standard.	Platinum Standard.	Total.	Loss on Ignition.	Free.	ALBUMINOID.				Nitrates.	Nitrites.		
						Total.	Dis-solved.	Sus-pended.					
Quinepoxet River, Holden,	.47	.44	3.69	1.68	.0015	.0229	.0192	.0037	.26	.0065	.0002	.65	0.5
Stillwater River, Sterling,	.42	.40	3.23	1.48	.0015	.0184	.0164	.0020	.16	.0043	.0001	.57	0.7
Nashua River, Clinton,	.35	.36	3.75	1.44	.0017	.0183	.0152	.0031	.22	.0070	.0001	.46	1.1
Marlborough (Walker's) Brook,	.31	.34	16.34	5.01	.1139	.0471	.0334	.0137	2.15	.2100	.0074	.62	5.6
Marlborough Brook filter beds, effluent,	.09†	.17	14.30	-	.0504	.0190	-	-	1.97	.2147	.0005	.29	5.0
Sudbury Reservoir, surface,*	.25	.29	4.03	1.51	.0025	.0169	.0143	.0026	.24	.0131	.0001	.40	1.4
Sudbury Reservoir, mid-depth,*	.26	.30	4.08	1.52	.0034	.0154	.0136	.0018	.24	.0145	.0001	.41	1.5
Sudbury Reservoir, bottom,*	.25	.29	4.14	1.54	.0038	.0152	.0136	.0016	.25	.0157	.0001	.41	1.5
Framingham Reservoir No. 3, near dam,	.24	.29	4.49	1.57	.0021	.0164	.0142	.0022	.25	.0156	.0001	.42	1.5
Hopkinton Reservoir, influent,	1.78	1.85	7.24	4.07	.0049	.0423	.0408	.0015	.42	.0080	.0001	1.65	1.7
Hopkinton Reservoir, surface,	.59	.51	4.12	1.77	.0039	.0249	.0222	.0027	.29	.0055	.0001	.78	1.1
Hopkinton Reservoir, bottom,	.55	.49	4.42	1.82	.0046	.0224	.0195	.0029	.30	.0080	.0001	.76	1.1
Ashland Reservoir, influent,	1.66	1.26	6.36	3.42	.0062	.0440	.0407	.0033	.27	.0055	.0001	1.78	1.4
Ashland Reservoir, surface,	.65	.55	4.07	1.77	.0026	.0251	.0232	.0019	.24	.0037	.0001	.82	1.0
Ashland Reservoir, bottom,	.59	.51	4.21	1.80	.0029	.0227	.0206	.0021	.23	.0062	.0001	.76	1.0
Framingham Reservoir No. 2, influent,	1.01	.82	5.56	2.46	.0042	.0320	.0292	.0028	.36	.0115	.0002	1.16	1.4
Framingham Reservoir No. 2, near dam,	.90	.70	5.27	2.27	.0050	.0274	.0253	.0021	.33	.0105	.0001	1.02	1.3
Lake Cochituate,	.26	.30	5.17	1.86	.0042	.0239	.0200	.0039	.41	.0102	.0002	.48	2.1
Terminal chamber, Sudbury Aqueduct,	.27	.31	4.02	1.47	.0020	.0165	.0147	.0018	.25	.0159	.0001	.42	1.5
Spot Pond,	.08	.15	4.73	1.50	.0014	.0171	.0146	.0025	.28	.0042	.0001	.31	2.0
Tap at State House,	.24	.29	4.43	1.64	.0013	.0158	.0142	.0016	.30	.0173	.0001	.42	1.7

* These examinations were made weekly.

† Exclusive of March.

TABLE No. 33. — *Chemical Examinations of Water from a Faucet in Boston, from 1888 to 1901.*

[Parts per 100,000.]

YEARS.	COLOR.		RESIDUE ON EVAPORATION.		AMMONIA.				Chlorine.	NITROGEN AS		Oxygen Consumed.	Hardness.
						ALBUMINOID.							
	Nessler Standard.	Platinum Standard.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1888, . .	.38	.38	4.94	1.53	.0012	.0215	-	-	.40	.0183	.0002	-	-
1889, . .	.51	.46	4.71	1.48	.0005	.0199	.0176	.0023	.42	.0272	.0002	-	-
1890, . .	.35	.36	4.70	1.25	.0008	.0169	.0148	.0021	.42	.0241	.0001	-	2.2
1891, . .	.37	.38	4.89	1.63	.0005	.0161	.0136	.0025	.37	.0227	.0001	-	1.7
1892, . .	.37	.37	4.70	1.67	.0007	.0168	.0138	.0030	.41	.0210	.0001	-	1.9
1893, . .	.61	.53	4.54	1.84	.0010	.0174	.0147	.0027	.38	.0143	.0001	.60	1.8
1894, . .	.69	.58	4.64	1.83	.0006	.0169	.0150	.0019	.41	.0106	.0001	.63	1.7
1895, . .	.72	.59	4.90	2.02	.0006	.0197	.0175	.0022	.40	.0171	.0001	.69	0.7
1896, . .	.49	.45	4.29	1.67	.0005	.0165	.0142	.0023	.37	.0155	.0001	.56	1.4
1897, . .	.65	.55	4.82	1.84	.0009	.0193	.0177	.0016	.40	.0137	.0001	.64	1.6
1898, . .	.41	.40	4.19	1.60	.0008	.0152	.0136	.0016	.29	.0097	.0001	.44	1.4
1899, . .	.23	.28	3.70	1.30	.0006	.0136	.0122	.0014	.24	.0137	.0001	.35	1.1
1900, . .	.24	.29	3.80	1.20	.0012	.0157	.0139	.0018	.25	.0076	.0001	.38	1.3
1901, . .	.24	.29	4.43	1.64	.0013	.0158	.0142	.0016	.30	.0173	.0001	.42	1.7

TABLE No. 34. — *Microscopical Examinations of Water from Various Parts of the Metropolitan Water Works, 1901 (Means of Weekly Determinations).*

Nashua River at Head of Wachusett Aqueduct.

[Standard units per cubic centimeter.]

MONTHS.	ORGANISMS.	AMORPHOUS.	Principal Organisms.
	Surface.	Surface.	
January, ...	38	34	Diatomaceæ.
February, ...	19	29	Infusoria.
March, ...	51	60	Diatomaceæ. Infusoria.
April, ...	32	62	Infusoria.
May, ...	88	41	Diatomaceæ.
June, ...	96	44	Diatomaceæ. Infusoria. Rotifera.
July, ...	151	58	Diatomaceæ. Chlorophyceæ. Infusoria. Rotifera.
August, ...	87	64	Rotifera.
September, ...	55	57	Infusoria. Rotifera. Crenothrix.
October, ...	96	56	Infusoria. Rotifera.
November, ...	30	41	Diatomaceæ.
December, ...	40	35	Diatomaceæ.
Mean, ...	65	48	

TABLE No. 34 — *Continued.*

Sudbury Reservoir, 1901.

[Standard units per cubic centimeter.]

MONTHS.	Organisms.				Amorphous.				Principal Organisms in the Reservoir.
	Surface.	Mid-depth.	Bottom.	End of Open Channel.	Surface.	Mid-depth.	Bottom.	End of Open Channel.	
January,	30	48	54	6	36	31	35	34	Diatomaceæ. Infusoria. Rotifera.
February,	119	22	21	20	22	24	32	22	Infusoria. Rotifera.
March,	316	42	24	8	45	41	40	53	Infusoria.
April,	223	158	141	26	42	41	46	37	Diatomaceæ. Infusoria. Rotifera.
May,	502	400	319	62	41	36	34	32	Diatomaceæ. Infusoria. Rotifera.
June,	102	71	79	107	26	27	25	36	Diatomaceæ. Chlorophyceæ. Cyanophyceæ.
July,	339	216	115	196	22	30	23	38	Diatomaceæ. Chlorophyceæ. Cyanophyceæ.
August,	1,159	937	708	113	31	33	31	42	Diatomaceæ. Cyanophyceæ. Rotifera.
September,	281	263	367	89	45	46	50	59	Diatomaceæ. Infusoria. Cyanophyceæ. Rotifera.
October,	295	309	276	51	27	28	26	34	Diatomaceæ. Infusoria. Cyanophyceæ. Rotifera.
November,	474	496	399	31	32	32	34	34	Diatomaceæ. Cyanophyceæ.
December,	206	292	196	20	20	25	28	22	Diatomaceæ. Cyanophyceæ. Rotifera.
Mean,	337	271	225	61	32	33	34	37	

Framingham Reservoir No. 3, 1901.

[Standard units per cubic centimeter.]

MONTHS.	Organisms.			Amorphous.			Principal Organisms.
	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.	
January,	123	89	118	37	39	39	Diatomaceæ. Infusoria. Rotifera.
February,	40	58	42	24	29	29	Diatomaceæ. Infusoria. Rotifera.
March,	186	115	73	43	45	43	Diatomaceæ. Infusoria. Rotifera.
April,	417	344	242	45	43	47	Diatomaceæ. Infusoria. Rotifera.
May,	647	467	495	40	37	41	Diatomaceæ. Infusoria. Rotifera.
June,	285	271	320	27	28	32	Diatomaceæ. Infusoria. Rotifera.
July,	168	151	141	22	27	29	Diatomaceæ. Chlorophyceæ. Cyanophyceæ.
August,	610	425	389	33	36	55	Diatomaceæ. Chlorophyceæ. Cyanophyceæ.
September,	456	606	484	55	66	57	Diatomaceæ. Cyanophyceæ. Chlorophyceæ.
October,	407	476	390	39	42	40	Diatomaceæ. Infusoria. Cyanophyceæ. Crenothrix.
November,	455	505	423	32	42	44	Diatomaceæ. Infusoria.
December,	237	165	244	26	24	25	Diatomaceæ.
Mean,	336	306	280	35	38	40	

TABLE No. 34 — *Continued.*

Whitehall Reservoir, 1901.

[Standard units per cubic centimeter.]

MONTHS.	ORGANISMS.	AMORPHOUS.	Principal Organisms.
	Surface.	Surface.	
January,	626	79	Infusoria. Rotifera.
February,	1,082	46	Infusoria. Rotifera.
March,	269	52	Infusoria. Rotifera.
April,	705	40	Infusoria. Rotifera.
May,	479	49	Diatomaceæ. Chlorophyceæ. Infusoria. Rotifera.
June,	641	43	Diatomaceæ. Chlorophyceæ. Infusoria. Rotifera.
July,	545	62	Diatomaceæ. Chlorophyceæ. Cyanophyceæ. Infusoria. Rotifera.
August,	725	40	Diatomaceæ. Chlorophyceæ. Cyanophyceæ. Infusoria. Rotifera.
September,	618	36	Diatomaceæ. Infusoria. Rotifera.
October,	484	28	Infusoria. Rotifera.
November,	2,071	34	Infusoria. Rotifera.
December,	217	25	Diatomaceæ.
Mean,	705	45	

Hopkinton Reservoir, 1901.

[Standard units per cubic centimeter.]

MONTHS.	ORGANISMS.				AMORPHOUS.				Principal Organisms in the Reservoir.
	Surface.	Mid-depth.	Bottom.	Inlet.	Surface.	Mid-depth.	Bottom.	Inlet.	
January,	178	222	111	14	30	32	41	26	Diatomaceæ. Infusoria.
February,	313	162	280	39	21	23	22	21	Diatomaceæ. Infusoria. Rotifera.
March,	36	43	80	34	45	52	61	39	Crenothrix.
April,	358	237	184	95	40	35	41	33	Diatomaceæ. Infusoria. Rotifera.
May,	957	865	475	61	36	37	41	24	Diatomaceæ. Infusoria.
June,	1,123	451	357	60	29	30	30	22	Diatomaceæ. Cyanophyceæ. Infusoria. Rotifera.
July,	692	364	114	23	27	30	28	19	Diatomaceæ. Chlorophyceæ. Cyanophyceæ.
August,	417	221	217	27	34	28	37	28	Chlorophyceæ. Cyanophyceæ.
September,	500	420	274	19	30	29	38	21	Chlorophyceæ. Cyanophyceæ. Infusoria. Rotifera.
October,	454	304	328	26	21	21	23	16	Cyanophyceæ. Infusoria.
November,	220	287	229	17	20	21	22	21	Cyanophyceæ. Infusoria.
December,	154	85	116	17	25	26	27	27	Cyanophyceæ. Infusoria. Rotifera.
Mean,	450	305	230	36	30	30	34	25	

TABLE No. 34 — *Continued.*

Ashland Reservoir, 1901.

[Standard units per cubic centimeter.]

MONTHS.	ORGANISMS.				AMORPHOUS.				Principal Organisms in the Reservoir.
	Surface.	Mid-depth.	Bottom.	Inlet.	Surface.	Mid-depth.	Bottom.	Inlet.	
January, . .	70	92	92	16	22	28	28	27	Diatomaceæ.
February, .	105	105	98	22	21	21	30	23	Diatomaceæ. Infusoria. Rotifera. Crenothrix.
March, . .	70	78	77	21	47	45	40	44	Diatomaceæ. Infusoria. Rotifera. Crenothrix.
April, . .	161	157	82	53	42	42	43	38	Diatomaceæ. Infusoria. Rotifera.
May, . .	257	155	44	59	33	36	40	35	Diatomaceæ. Infusoria. Rotifera.
June, . .	669	265	62	49	28	30	30	34	Diatomaceæ. Infusoria. Rotifera.
July, . .	226	71	40	28	20	19	28	35	Diatomaceæ. Chlorophyceæ. Cyanophyceæ. Infusoria. Rotifera.
August, . .	503	128	56	32	32	36	30	31	Diatomaceæ. Cyanophyceæ.
September, .	268	121	91	49	23	21	28	32	Diatomaceæ. Cyanophyceæ. Infusoria. Rotifera.
October, . .	256	220	158	26	18	17	16	17	Diatomaceæ. Cyanophyceæ.
November, .	242	181	196	16	23	22	20	20	Diatomaceæ. Cyanophyceæ.
December, .	104	146	169	46	25	22	22	24	Diatomaceæ. Cyanophyceæ.
Mean, .	244	144	97	35	28	28	29	30	

Framingham Reservoir No. 2, 1901.

[Standard units per cubic centimeter.]

MONTHS.	ORGANISMS.				AMORPHOUS.				Principal Organisms in the Reservoir.
	Surface.	Mid-depth.	Bottom.	Inlet.	Surface.	Mid-depth.	Bottom.	Inlet.	
January, . .	52	22	9	12	37	38	38	38	Infusoria.
February, .	54	13	12	54	22	21	21	23	Infusoria.
March, . .	29	18	30	85	58	48	42	58	Infusoria.
April, . .	118	94	64	140	36	33	37	34	Diatomaceæ. Infusoria.
May, . .	169	124	83	113	36	36	35	33	Diatomaceæ. Infusoria.
June, . .	285	135	108	70	21	29	30	41	Diatomaceæ. Cyanophyceæ. Infusoria. Rotifera.
July, . .	460	478	260	92	25	21	24	22	Chlorophyceæ. Cyanophyceæ.
August, . .	563	393	256	112	33	37	33	35	Chlorophyceæ. Cyanophyceæ.
September, .	261	142	162	171	60	92	86	69	Cyanophyceæ. Crenothrix.
October, . .	317	282	440	75	31	42	31	26	Cyanophyceæ. Infusoria. Crenothrix.
November, .	33	37	34	55	34	31	32	30	Diatomaceæ. Infusoria. Crenothrix.
December, .	31	52	25	65	24	24	22	25	Diatomaceæ.
Mean, .	198	149	124	87	34	37	36	36	

TABLE NO. 34 — *Continued.*

Lake Cochituate, opposite Gate-house.

[Standard units per cubic centimeter.]

MONTHS.	ORGANISMS.			AMORPHOUS.			Principal Organisms.
	Surface.	Mid-depth.	Bottom.	Surface	Mid-depth.	Bottom.	
January,	1,139	1,653	1,576	52	52	48	Diatomaceæ. Cyanophyceæ. Infusoria. Rotifera.
February,	446	525	506	48	46	58	Diatomaceæ. Cyanophyceæ. Infusoria. Rotifera.
March,	255	128	154	46	42	47	Diatomaceæ. Cyanophyceæ. Infusoria. Rotifera.
April,	574	659	403	45	50	55	Diatomaceæ. Cyanophyceæ. Infusoria. Rotifera.
May,	1,463	538	522	51	52	42	Diatomaceæ. Cyanophyceæ. Infusoria.
June,	1,913	348	304	46	38	75	Diatomaceæ. Cyanophyceæ. Infusoria.
July,	582	270	368	41	51	174	Cyanophyceæ.
August,	861	392	648	43	50	306	Cyanophyceæ. Crenothrix.
September,	1,146	249	434	49	72	364	Cyanophyceæ. Infusoria. Rotifera. Crenothrix.
October,	441	457	351	38	42	237	Cyanophyceæ. Infusoria. Rotifera. Crenothrix.
November,	1,508	1,451	1,097	34	36	46	Diatomaceæ. Cyanophyceæ. Infusoria. Rotifera. Crenothrix.
December,	1,572	1,435	2,056	27	26	37	Diatomaceæ. Cyanophyceæ.
Mean,	992	675	702	48	46	124	

Chestnut Hill Reservoir, 1901.

[Standard units per cubic centimeter.]

MONTHS.	ORGANISMS.					AMORPHOUS.					Principal Organisms in the Reservoir.
	Surface.	Mid depth.	Bottom.	Inlet (Sudbury Aqueduct).	Inlet (Cochituate Aqueduct).	Surface.	Mid-depth.	Bottom.	Inlet (Sudbury Aqueduct).	Inlet (Cochituate Aqueduct).	
January,	-	-	-	126	899	-	-	-	43	42	- - -
February,	-	-	-	190	334	-	-	-	43	42	- - -
March,	-	-	-	155	268	-	-	-	47	43	- - -
April,	339	206	336	238	394	45	47	47	51	40	Diatomaceæ. Infusoria. Rotifera.
May,	405	451	398	594	669	44	52	46	46	39	Diatomaceæ. Infusoria. Rotifera.
June,	299	266	239	420	1,138	37	36	36	48	52	Diatomaceæ. Chlorophyceæ. Infusoria. Rotifera.
July,	311	216	83	117	656	32	28	32	30	42	Diatomaceæ. Chlorophyceæ. Cyanophyceæ.
August,	517	350	138	602	749	41	51	108	41	34	Diatomaceæ. Chlorophyceæ. Cyanophyceæ. Infusoria. Rotifera. Crenothrix.
September,	971	852	348	560	978	56	52	240	70	49	Diatomaceæ. Cyanophyceæ. Infusoria. Rotifera. Crenothrix.
October,	512	440	612	362	656	37	42	64	39	32	Diatomaceæ. Chlorophyceæ. Cyanophyceæ. Infusoria. Rotifera. Crenothrix.
November,	572	516	409	554	928	43	43	36	43	36	Diatomaceæ. Cyanophyceæ. Infusoria. Rotifera. Crenothrix.
December,	-	-	-	212	-	-	-	-	24	-	- - -
Mean,	491	412	320	344	697	42	44	76	44	41	

TABLE No. 34 — *Continued.*

Outlet from Chestnut Hill Reservoir and Taps in Boston.

[Standard units per cubic centimeter.]

MONTHS.	ORGANISMS.			AMORPHOUS.		
	Effluent Gate-house No 2, Chestnut Hill Reservoir.	Low-service Tap at No. 244 Boylston Street, Boston.	High-service Tap at No. 1 Ashburton Place, Boston.	Effluent Gate-house No. 2, Chestnut Hill Reservoir.	Low-service Tap at No. 244 Boylston Street, Boston.	High-service Tap at No. 1 Ashburton Place, Boston.
January,	402	353	307	44	41	41
February,	162	220	85	40	41	43
March,	105	72	79	46	43	39
April,	365	148	437	48	38	58
May,	522	365	448	38	48	44
June,	348	155	219	30	35	41
July,	277	156	114	31	27	28
August,	561	300	265	36	37	37
September,	920	379	433	59	54	58
October,	509	216	288	40	32	32
November,	451	289	349	34	36	53
December,	332	263	340	27	28	29
Mean,	413	243	280	39	38	42

TABLE NO. 34 — *Concluded.*

Spot Pond and Fells Reservoir, 1901.

[Standard units per cubic centimeter.]

MONTHS.	ORGANISMS.				AMORPHOUS.				PRINCIPAL ORGANISMS.	
	SPOT POND.			FELLS RESERVOIR.	SPOT POND.			FELLS RESERVOIR.		
	Surface.	Mid-depth.	Bottom.	Effluent Gate-house.	Surface.	Mid-depth.	Bottom.	Effluent Gate-house.	Spot Pond.	Fells Reservoir.
January, ...	1,024	1,104	978	814	46	50	49	45	Diatomaceæ. Infusoria. Rotifera.	Diatomaceæ. Infusoria. Rotifera.
February, ...	814	907	585	509	49	47	46	46	Diatomaceæ. Infusoria. Rotifera.	Diatomaceæ. Infusoria. Rotifera.
March, ...	520	671	771	354	58	84	52	44	Diatomaceæ. Infusoria. Rotifera.	Diatomaceæ. Infusoria. Rotifera.
April, ...	1,096	869	829	751	47	47	53	52	Diatomaceæ. Infusoria.	Diatomaceæ. Infusoria. Rotifera.
May, ...	624	804	566	734	40	44	44	63	Diatomaceæ. Infusoria. Rotifera.	Diatomaceæ. Infusoria. Rotifera.
June, ...	416	361	337	340	38	38	41	34	Diatomaceæ. Cyanophyceæ. Infusoria. Rotifera.	Diatomaceæ. Infusoria. Rotifera.
July, ...	222	344	168	322	34	44	43	41	Diatomaceæ. Chlorophyceæ. Cyanophyceæ. Infusoria. Rotifera.	Diatomaceæ. Chlorophyceæ. Infusoria. Rotifera.
August, ...	366	200	248	300	33	36	38	34	Diatomaceæ. Chlorophyceæ. Cyanophyceæ. Infusoria.	Diatomaceæ. Chlorophyceæ. Cyanophyceæ. Infusoria. Rotifera.
September, ...	284	190	107	175	41	42	62	35	Diatomaceæ. Cyanophyceæ. Infusoria. Rotifera.	Diatomaceæ. Infusoria. Rotifera.
October, ...	543	476	381	447	33	34	38	32	Diatomaceæ. Cyanophyceæ. Infusoria. Rotifera.	Diatomaceæ. Cyanophyceæ. Infusoria.
November, ...	1,066	926	940	1,063	37	34	39	36	Diatomaceæ. Cyanophyceæ. Infusoria.	Diatomaceæ. Cyanophyceæ. Infusoria.
December, ...	563	625	674	673	28	26	30	30	Diatomaceæ. Infusoria.	Diatomaceæ. Infusoria.
Mean, ...	628	623	549	540	40	44	45	41		

TABLE No. 35. — *Bacterial Examinations of Water from Various Parts of the Metropolitan Water Works, 1901 (Means of Weekly Determinations).*

[Number of bacteria per cubic centimeter.]

MONTHS.	CHESTNUT HILL RESERVOIR.						Low-service Tap at No. 244 Boylston Street, Boston.	High-service Tap at No. 1 Ashburton Place, Boston.
	Surface.	Mid-depth.	Bottom.	Inlet (Sudbury Aqueduct).	Inlet (Cochituate Aqueduct).	Effluent Gate-house No. 2.		
January,	-	-	-	-	-	-	-	-
February,	-	-	-	70	58	61	66	73
March,	-	-	-	1,297	669	1,011	749	574
April,	186	195	221	393	81	203	105	185
May,	84	104	81	150	94	186	67	81
June,	26	24	32	82	45	28	79	104
July,	31	34	21	57	37	24	167	74
August,	25	28	28	108	289	48	74	122
September,	45	108	69	44	47	64	87	126
October,	97	72	38	83	52	63	102	149
November,	114	105	82	91	127	114	111	163
December,	-	-	-	203	-	110	170	198
Mean,	76	84	72	225	149	169	162	168

TABLE No. 36. — *Examinations of Water from Brooks entering Reservoirs, 1901 (Means of Monthly Determinations).*

Brooks entering Lake Cochituate.

[Temperature in degrees Fahrenheit; turbidity by Silica standard; organisms and amorphous matter in standard units per cubic centimeter, bacteria in number per cubic centimeter, and color by platinum standard.]

	Temperature. (Degrees.)	Turbidity.	Organisms.	Amorphous.	Bacteria.
Beaver Dam Brook,	51.8	6.6	525	47	1,438
Beaver Dam Brook (last culvert),	53.7	6.1	287	49	2,459
Course Brook,	53.5	3.0	65	28	916
Dug Pond,	53.1	7.9	718	44	826
Circular dam at south end of lake,	53.7	4.3	289	38	980
Pegan Brook,	54.0	79.3	220	81	5,019
Snake Brook,	53.1	10.2	67	112	1,806

Brooks entering Sudbury Reservoir and Framingham Reservoir No. 3.

	Color.	Turbidity.	Organisms.	Amorphous.
Angelico Brook,	0.70	1.7	34	18
Brewer Brook,	0.55	2.3	31	18
Deerfoot Brook,	0.86	3.8	55	28
Rock Meadow Brook,	0.95	1.9	34	16
Mowry Brook,*	0.49	8.2	53	26
Broad Meadow Brook,	0.53	2.6	31	22

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* Formerly called Brown Meadow Brook.

TABLE No. 37. — *Turbidity of Water from Various Parts of the Metropolitan Water Works, 1901 (Means of Weekly Determinations).*

[Silica standard.]

MONTHS.	NASHUA RIVER.	SUDBURY RESERVOIR.				FRAMINGHAM RESERVOIR NO. 3.			WHITEHALL RESERVOIR.
	Surface.	Surface.	Mid-depth.	Bottom.	End of Open Channel.	Surface.	Mid-depth.	Bottom.	Surface.
January,	2.5	3.0	3.5	3.8	3.8	2.8	3.5	3.8	3.5
February,	2.8	2.0	2.3	3.0	2.6	2.5	2.8	2.8	1.9
March,	19.8	4.6	2.4	2.4	15.8	2.8	3.0	3.8	2.6
April,	9.3	3.0	3.5	3.5	2.6	3.3	4.0	4.0	1.9
May,	3.3	2.0	2.0	2.1	2.6	2.1	2.4	3.4	3.0
June,	4.0	2.5	3.0	3.0	2.8	2.0	2.0	2.8	2.1
July,	7.6	2.1	1.9	2.4	3.0	1.9	2.6	2.6	1.9
August,	3.5	1.9	1.9	2.0	2.5	1.9	2.1	2.8	2.1
September,	3.6	1.9	2.4	2.3	3.0	2.1	2.2	2.6	2.6
October,	3.5	1.9	2.0	2.2	3.8	2.2	2.2	2.4	2.4
November,	6.0	4.5	4.8	5.1	7.3	3.5	3.8	4.0	4.0
December,	3.3	3.5	3.8	4.0	3.3	3.8	4.0	4.3	3.0
Mean,	6.2	2.7	2.8	3.0	4.4	2.5	2.9	3.2	2.6

[Silica standard.]

MONTHS.	HOPKINTON RESERVOIR.				ASHLAND RESERVOIR.				FRAMINGHAM RESERVOIR NO. 2.			
	Surface.	Mid-depth.	Bottom.	Inlet.	Surface.	Mid-depth.	Bottom.	Inlet.	Surface.	Mid-depth.	Bottom.	Inlet.
January,	2.5	2.5	5.5	2.0	2.0	2.0	2.8	2.0	2.0	2.0	2.0	2.8
February,	1.8	1.9	3.3	1.5	1.5	1.9	2.1	1.5	1.8	2.0	1.8	2.8
March,	2.1	2.4	3.6	4.1	2.4	2.6	2.9	5.8	6.6	6.1	6.1	3.8
April,	1.9	1.9	1.9	1.6	1.6	1.6	1.5	1.5	1.8	1.8	2.0	1.8
May,	1.7	2.1	2.0	1.6	1.6	1.8	1.7	1.5	1.6	2.0	2.3	2.8
June,	1.6	1.5	1.6	1.5	1.5	1.6	1.9	1.9	1.8	1.6	1.8	1.9
July,	1.4	1.6	1.8	1.5	1.4	1.5	1.7	1.6	1.7	1.7	1.8	1.6
August,	1.8	1.9	2.0	1.6	1.6	1.6	1.9	2.1	1.8	1.9	2.6	1.9
September,	1.9	1.9	3.1	1.8	1.8	1.8	1.9	1.8	2.4	2.6	2.9	2.5
October,	1.6	2.5	3.3	1.5	1.6	1.5	1.6	1.6	1.8	1.8	1.8	1.8
November,	3.0	3.3	3.5	2.8	2.1	2.1	2.1	2.1	1.9	2.0	2.3	2.0
December,	2.8	2.8	2.8	2.1	2.0	2.3	2.5	2.4	2.3	2.5	3.0	3.0
Mean,	2.0	2.2	2.9	2.0	1.8	1.9	2.1	2.2	2.3	2.3	2.5	2.3

TABLE No. 37 — *Concluded.*

[Silica standard.]

MONTHS.	FRAMINGHAM RESERVOIR No. 1.	LAKE COCHITUATE.			SPOT POND.			FELLS RESERVOIR.
	Surface.	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.	Effluent Gate-house.
January,	2.0	2.5	2.8	3.0	3.8	5.0	4.8	4.5
February,	2.5	1.8	2.1	2.4	2.0	2.0	2.3	2.0
March,	6.6	2.4	2.5	5.7	5.5	3.0	2.0	2.9
April,	1.6	2.3	2.5	2.8	2.3	3.0	3.8	2.1
May,	1.8	2.3	2.4	2.8	2.8	4.3	5.2	3.2
June,	2.3	2.1	2.5	5.8	2.5	2.9	3.5	3.0
July,	3.6	1.9	1.9	16.8	2.0	2.6	3.5	3.7
August,	2.5	1.9	2.0	19.5	2.0	2.3	2.3	2.0
September,	3.5	2.1	2.3	15.3	2.5	3.0	4.3	2.0
October,	2.6	1.9	1.9	3.9	1.3	2.3	3.4	2.1
November,	4.0	3.0	3.8	5.3	3.0	3.5	4.3	3.4
December,	2.3	2.3	2.8	4.3	2.5	3.0	4.8	2.9
Mean,	2.9	2.2	2.5	7.3	2.7	3.1	3.7	2.8

[Silica standard.]

MONTHS.	CHESTNUT HILL RESERVOIR.						Tap at No. 244 Boylston Street, Boston.	Tap at No. 1 Ashburton Place, Boston.
	Surface.	Mid-depth.	Bottom.	Inlet (Sudbury Aqueduct).	Inlet (Cochituate Aqueduct).	Effluent Gatehouse No. 2.		
January,	-	-	-	2.0	2.0	2.0	2.0	2.0
February,	-	-	-	2.4	1.6	1.8	1.6	1.5
March,	-	-	-	3.3	1.8	2.3	2.1	2.1
April,	2.3	2.7	3.0	2.8	1.6	2.5	1.9	3.3
May,	2.2	2.7	2.5	2.2	2.8	2.4	1.7	2.8
June,	2.5	2.5	2.8	2.5	1.6	2.8	1.8	3.1
July,	2.1	3.0	3.8	3.0	1.8	2.2	1.9	2.1
August,	1.8	2.8	10.6	2.9	2.6	2.9	2.0	2.3
September,	2.4	3.0	6.8	2.5	2.5	2.0	2.1	2.4
October,	2.0	2.2	3.7	2.6	1.9	2.1	1.9	2.0
November,	3.0	3.0	3.0	3.3	4.0	3.3	1.9	3.0
December,	-	-	-	2.5	-	2.3	2.5	2.5
Mean,	2.3	2.7	4.5	2.7	2.2	2.4	2.0	2.4

TABLE No. 38. — *Colors of Water from Various Parts of the Metropolitan Water Works, 1901 (Means of Weekly Determinations).*

[Platinum standard.]

MONTHS.	NASHUA RIVER.	SUDBURY RESERVOIR.				FRAMINGHAM RESERVOIR No. 3.			WHITEHALL RESERVOIR.
	Surface.	Surface.	Mid-depth.	Bottom.	End of Open Channel.	Surface.	Mid-depth.	Bottom.	Surface.
January,	0.39	0.43	0.47	0.47	0.37	0.49	0.48	0.49	0.63
February,	0.33	0.37	0.40	0.40	0.29	0.40	0.41	0.41	0.64
March,	0.56	0.35	0.34	0.33	0.52	0.35	0.35	0.36	0.63
April,	0.45	0.34	0.33	0.34	0.55	0.34	0.35	0.36	0.51
May,	0.55	0.37	0.36	0.36	0.64	0.37	0.38	0.38	0.59
June,	0.50	0.39	0.40	0.41	0.56	0.36	0.37	0.40	0.64
July,	0.48	0.31	0.34	0.35	0.46	0.28	0.31	0.35	0.60
August,	0.57	0.23	0.23	0.25	0.53	0.24	0.24	0.38	0.57
September,	0.48	0.24	0.25	0.26	0.48	0.25	0.25	0.28	0.52
October,	0.54	0.23	0.22	0.24	0.56	0.23	0.23	0.23	0.52
November,	0.44	0.24	0.25	0.27	0.44	0.24	0.24	0.24	0.60
December,	0.53	0.35	0.35	0.37	0.50	0.35	0.35	0.36	0.52
Mean,	0.49	0.32	0.33	0.34	0.49	0.33	0.33	0.35	0.58

[Platinum standard.]

MONTHS.	HOPKINTON RESERVOIR.				ASHLAND RESERVOIR.				FRAMINGHAM RESERVOIR No. 2.			
	Surface.	Mid-depth.	Bottom.	Inlet.	Surface.	Mid-depth.	Bottom.	Inlet.	Surface.	Mid-depth.	Bottom.	Inlet.
January,	0.60	0.61	0.67	1.03	0.58	0.59	0.64	1.05	0.77	0.84	0.86	0.69
February,	0.60	0.66	0.69	1.05	0.58	0.62	0.67	0.89	0.70	0.76	0.77	0.64
March,	0.53	0.56	0.61	0.87	0.58	0.59	0.60	0.75	0.64	0.64	0.65	0.64
April,	0.54	0.55	0.55	1.03	0.58	0.58	0.53	0.86	0.66	0.67	0.67	0.70
May,	0.70	0.68	0.68	1.54	0.74	0.73	0.69	1.46	0.93	0.93	0.92	1.00
June,	0.85	0.75	0.71	2.01	0.87	0.83	0.68	1.58	1.06	1.06	1.04	1.20
July,	0.77	0.68	0.62	2.26	0.78	0.75	0.64	1.70	0.96	0.97	0.99	1.20
August,	0.71	0.65	0.63	2.30	0.74	0.75	0.64	1.85	0.94	0.93	1.04	1.21
September,	0.73	0.68	0.71	2.28	0.77	0.76	0.66	2.33	1.10	1.09	1.07	1.24
October,	0.70	0.67	0.75	1.93	0.74	0.72	0.67	1.84	0.99	0.96	0.97	1.12
November,	0.69	0.64	0.66	1.34	0.71	0.71	0.71	1.26	0.92	0.91	0.91	0.80
December,	0.71	0.70	0.70	1.27	0.73	0.70	0.71	1.14	0.80	0.82	0.82	0.81
Mean,	0.68	0.65	0.67	1.57	0.70	0.69	0.66	1.39	0.87	0.88	0.89	0.94

TABLE NO. 38 — *Concluded.*

[Platinum standard.]

MONTHS.	FRAMINGHAM RESERVOIR No. 1.	LAKE COCHITUATE.				SPOT POND.			FELLS RESERVOIR.
	Surface.	Surface.	Mid-depth.	Bottom.	Influent Streams.*	Surface.	Mid-depth.	Bottom.	Effluent Gate-house.
January,	0.86	0.30	0.31	0.33	0.62	0.17	0.19	0.19	0.24
February,	0.73	0.29	0.33	0.32	0.64	0.21	0.21	0.21	0.30
March,	0.61	0.28	0.31	0.56	0.73	0.21	0.23	0.22	0.31
April,	0.64	0.34	0.34	0.34	0.81	0.20	0.20	0.21	0.28
May,	0.86	0.38	0.33	0.36	1.04	0.17	0.18	0.21	0.22
June,	0.94	0.45	0.30	0.59	1.07	0.16	0.18	0.18	0.25
July,	0.81	0.35	0.28	1.00	1.10	0.09	0.13	0.16	0.15
August,	0.80	0.36	0.29	1.96	1.38	0.10	0.10	0.13	0.10
September,	0.92	0.33	0.30	2.23	1.36	0.11	0.12	0.15	0.11
October,	0.78	0.29	0.28	2.08	1.04	0.09	0.10	0.12	0.09
November,	0.90	0.33	0.34	0.72	0.90	0.11	0.11	0.12	0.10
December,	0.83	0.32	0.31	0.36	0.89	0.11	0.13	0.14	0.23
Mean,	0.81	0.33	0.31	0.90	0.97	0.14	0.16	0.17	0.20

* The colors given in this column represent the combined colors of the water of the four principal feeders. The color of each is determined monthly, and due weight is given, in combining the results, to the sizes of the streams.

[Platinum standard.]

MONTHS.	CHESTNUT HILL RESERVOIR.						Tap at No. 244 Boylston Street, Boston (Low-service).	Tap at No. 1 Ashburton Place, Boston (High-service).
	Surface.	Mid-depth.	Bottom.	Inlet (Sudbury Aqueduct).	Inlet (Cochituate Aqueduct).	Effluent Gate-house No. 2.		
January,	-	-	-	0.48	0.32	0.45	0.44	0.43
February,	-	-	-	0.45	0.32	0.41	0.41	0.41
March,	-	-	-	0.44	0.32	0.44	0.45	0.41
April,	0.33	0.33	0.34	0.35	0.28	0.31	0.30	0.33
May,	0.33	0.33	0.32	0.36	0.28	0.32	0.34	0.33
June,	0.39	0.39	0.36	0.42	0.42	0.39	0.40	0.48
July,	0.39	0.40	0.36	0.43	0.35	0.40	0.39	0.38
August,	0.29	0.28	0.62	0.29	0.34	0.28	0.29	0.31
September,	0.26	0.26	1.01	0.24	0.32	0.26	0.27	0.29
October,	0.24	0.25	0.35	0.22	0.26	0.24	0.24	0.25
November,	0.22	0.22	0.22	0.24	0.29	0.22	0.23	0.23
December,	-	-	-	0.32	-	0.28	0.30	0.27
Mean,	0.31	0.31	0.45	0.35	0.32	0.33	0.34	0.34

TABLE No. 39. — *Temperatures of Water from Various Parts of the Metropolitan Water Works, 1901 (Means of Weekly Determinations).*

[The temperatures are taken at the same places and times as the samples for microscopical examination; the depth given for each reservoir is the depth from high-water mark where the temperatures are taken.]

[Degrees Fahrenheit.]

MONTHS.	NASHUA RIVER.	SUDBURY RESERVOIR (DEPTH AT PLACE OF OBSERVATION 54.5 FEET).				FRAMINGHAM RESERVOIR NO. 3 (DEPTH AT PLACE OF OBSERVATION 20.5 FEET).			HOPKINTON RESERVOIR (DEPTH AT PLACE OF OBSERVATION 54.3 FEET).		
	Surface.	Surface.	Mid-depth.	Bottom.	End of Open Channel.	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.
January,	32.6	34.6	37.2	38.7	32.6	33.8	35.6	36.5	35.8	37.2	38.7
February,	31.6	33.2	36.6	38.1	32.2	33.5	34.6	35.7	36.3	38.1	38.6
March,	35.4	35.4	37.2	39.2	34.6	35.8	36.6	37.3	41.5	42.8	42.9
April,	43.3	44.2	44.2	43.8	42.6	42.4	42.1	41.9	40.8	41.1	41.0
May,	56.6	61.1	58.0	51.1	54.7	56.0	54.7	53.5	55.8	48.3	46.9
June,	67.5	68.1	62.6	61.1	68.1	68.7	66.8	64.6	64.2	53.9	50.8
July,	77.5	78.7	71.2	68.1	76.9	77.7	74.8	71.0	75.7	59.8	52.5
August,	73.8	74.9	74.0	73.2	72.2	75.5	74.6	73.1	75.3	53.4	49.7
September,	69.8	70.1	69.8	69.1	67.6	69.7	70.4	70.6	70.2	52.7	49.6
October,	57.0	58.9	58.5	57.8	56.8	57.8	58.2	58.5	57.4	53.4	51.7
November,	39.0	42.5	42.8	42.3	38.5	42.1	42.6	42.9	43.8	44.3	44.8
December,	33.1	33.8	34.5	34.9	32.9	33.9	34.5	34.8	36.5	36.9	37.3
Mean,	51.4	53.0	51.8	51.4	50.8	52.2	52.1	51.7	52.8	46.7	45.4

[Degrees Fahrenheit.]

MONTHS.	ASHLAND RESERVOIR (DEPTH AT PLACE OF OBSERVATION 40.7 FEET).			FRAMINGHAM RESERVOIR NO. 2 (DEPTH AT PLACE OF OBSERVATION 20.5 FEET).			LAKE COCHITUATE (DEPTH AT PLACE OF OBSERVATION 62.0 FEET).			WHITEHALL RESERVOIR.
	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.	Surface.	Mid depth.	Bottom.	Surface.
January,	35.1	38.1	40.0	33.9	35.6	36.8	37.5	38.0	38.7	36.6
February,	34.7	38.7	40.4	33.0	34.6	36.0	36.0	37.6	39.0	33.6
March,	39.5	40.4	40.7	35.7	36.4	37.2	37.0	38.2	39.5	37.8
April,	41.7	41.3	41.8	42.8	42.5	42.0	42.0	41.4	41.0	43.9
May,	53.7	50.7	47.9	56.6	55.2	54.3	54.0	46.5	43.7	55.4
June,	67.7	56.5	48.7	71.2	68.3	65.5	67.7	46.5	43.8	66.8
July,	80.1	58.4	48.6	78.8	75.4	71.7	78.3	48.4	46.2	78.2
August,	75.0	59.3	49.8	75.3	74.5	73.2	75.4	49.0	47.0	74.8
September,	69.9	60.6	48.5	69.3	69.7	69.5	70.7	47.1	44.8	69.1
October,	56.3	54.3	47.2	57.5	57.9	58.2	58.0	48.0	44.4	57.3
November,	42.1	43.4	44.5	40.5	41.0	41.4	42.8	42.6	43.8	37.0
December,	38.0	37.5	37.5	33.7	34.4	34.8	35.9	36.9	36.6	34.0
Mean,	52.8	48.3	44.6	52.4	52.1	51.7	52.9	43.4	42.8	52.0

TABLE No. 39 — *Concluded.*

[Degrees Fahrenheit.]

MONTHS.	SPOT POND (DEPTH AT PLACE OF OBSERVATION 28.0 FEET).			CHESTNUT HILL RESERVOIR (DEPTH AT PLACE OF OBSERVATION 26.0 FEET).						Tap at No. 244, Boylston Street, Boston.	Tap at No. 1, Ashburton Place, Boston.
	Surface.	Mid-depth.	Bottom.	Surface.	Mid-depth.	Bottom.	Inlet (Sudbury Aqueduct).	Inlet (Cochituate Aqueduct).	Effluent Gate-house No. 2.		
January, . . .	36.0	37.1	37.8	-	-	-	37.1	37.5	36.1	37.1	39.2
February, . . .	37.0	38.3	38.6	-	-	-	36.7	38.4	35.3	36.5	38.1
March, . . .	37.8	39.0	39.5	-	-	-	38.3	39.1	37.8	38.9	39.4
April, . . .	41.3	41.5	41.5	40.9	41.9	42.3	42.6	42.7	43.0	44.4	44.1
May, ...	53.3	52.1	50.1	53.9	51.8	48.1	53.2	48.2	53.3	53.4	54.1
June, ...	64.4	63.4	61.5	64.3	61.3	48.6	61.7	63.1	64.0	63.0	63.6
July, ...	76.2	71.2	61.0	72.9	67.7	48.8	70.3	72.0	73.7	73.4	73.8
August, . . .	74.8	75.0	62.6	75.7	72.3	54.9	74.3	74.4	74.4	73.5	74.9
September, . .	71.1	71.4	64.3	70.5	71.6	54.5	71.4	71.4	71.3	71.3	71.8
October, . . .	59.0	59.4	59.3	59.9	57.9	55.2	57.9	57.9	60.0	60.8	60.7
November, . .	44.6	45.1	45.3	46.8	45.6	45.6	45.1	48.3	45.4	47.5	48.4
December, . . .	33.3	34.1	34.2	-	-	-	35.6	-	35.6	38.5	38.8
Mean, . . .	52.4	52.3	49.6	60.6	58.8	49.8	52.0	53.9	52.5	53.2	53.9

TABLE No. 40. — *Temperatures of the Air at Three Stations on the Metropolitan Water Works, 1901.*

[Degrees Fahrenheit.]

MONTHS.	CHESTNUT HILL RESERVOIR.			FRAMINGHAM.			CLINTON.		
	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.
January, ...	48.0	—6.0	25.8	48.0	—7.0	25.8	47.0	—7.0	24.2
February, . . .	45.5	5.0	22.4	44.0	6.0	22.3	38.5	5.5	20.9
March, ...	58.0	5.0	35.9	53.0	3.0	35.2	53.5	4.5	32.8
April, ...	80.0	30.5	44.0	82.0	31.0	45.5	82.0	29.0	43.9
May, ...	86.0	30.0	54.9	86.0	34.0	56.5	85.0	35.0	55.4
June, ...	99.0	42.0	68.2	98.0	44.0	68.9	95.0	41.0	68.0
July, ...	97.0	52.0	75.0	99.0	51.0	74.5	98.0	48.0	73.0
August, ...	90.5	54.0	72.0	87.0	52.0	71.2	85.0	53.5	70.0
September, . . .	90.0	38.0	65.2	89.0	36.0	64.5	85.5	32.5	62.9
October, ...	75.5	28.5	53.4	75.0	27.0	52.6	75.0	24.5	51.0
November, . . .	65.0	8.0	35.6	64.0	8.0	35.4	68.5	8.0	34.0
December, . . .	63.5	0.0	30.7	61.0	—5.0	28.5	60.0	—10.5	26.0
Averages, . . .	-	-	48.6	-	-	48.4	-	-	46.8

TABLE NO. 41. — *Table showing Length of Main Lines of Pipes and Connections owned and operated by Metropolitan Water and Sewerage Board and Number of Valves set in Same.*

	DIAMETER OF PIPES IN INCHES.													Totals.
	60	48	42	36	30	24	20	16	14	12	10	8	6	
Length owned and operated January 1, 1901 (feet),	307	124,125	8,075	46,496	26,839	40,930	51,509	54,379	26	13,374	489	1,389	740	368,678
Gate valves in same,	-	33	-	37	27	33	29	44	1	43	5	4	12	268
Air valves in same,	-	67	8	33	4	18	30	27	-	4	-	-	-	181
Length laid or relaid during 1901 (feet),	-	39	-	19	68	6,212	6,764	99	-	1,735	41	-	-	14,977
Gate valves in same,	-	-	-	-	-	1	4	4	-	4	2	-	-	15
Air valves in same,	-	-	-	-	-	7	5	1	-	-	-	-	-	13
Length abandoned during 1901 (feet),	-	1	-	8	-	538	1,492	494	-	958	-	-	-	3,486
Gate valves in same,	-	-	-	-	-	1	-	1	-	1	-	-	-	3
Air valves in same,	-	-	-	-	-	1	1	-	-	-	-	-	-	2
Total length owned and operated January 1, 1902 (feet),	307	124,163	8,075	46,512	26,907	46,604	56,781	53,984	26	14,151	530	1,389	740	380,169*
Gate valves in same,	-	33	-	37	27	33	33	47	1	46	7	4	12	280
Air valves in same,	-	67	8	33	4	19	34	28	-	4	-	-	-	192

* 72 miles.

TABLE NO. 42. — *Statement of Cast-iron Hydrant, Blow-off and Drain Pipes laid to January 1, 1902, owned and operated by Metropolitan Water and Sewerage Board.*

	DIAMETER OF PIPES IN INCHES.							Totals.
	24	16	12	10	8	6	4	
Length laid to January 1, 1901 (feet),	352	2,110	3,162	-	98	2,109	981	8,812
Length laid during 1901 (feet),	-	-	334	107	155	500	32	1,128
Length abandoned during 1901 (feet),	-	-	6	-	160	5	34	205
Total length in use January 1, 1902 (feet),	352	2,110	3,490	107	93	2,604	979	9,735
Valves set to January 1, 1901,	-	16	57	-	-	44	35	152
Valves set during 1901,	-	-	-	1	1	9	1	12
Valves abandoned during 1901,	-	-	-	-	1	-	2	3
Total valves in use January 1, 1902,	-	16	57	1	-	53	34	161

TABLE NO. 43. — *Length of Water Pipes, Four Inches in Diameter and Larger, in the Several Cities and Towns supplied by the Metropolitan Water Works.*

BY WHOM OWNED.	INCHES.																			TOTAL.	
	60	48	42	40	36	30	28	24	20	18	16	14	12	10	8	7	6	5	4	Feet.	Miles.
Metropolitan Water Works.	307	124,163	8,075	-	46,512	26,907	-	46,604	56,781	-	53,984	26	14,151	530	1,389	-	740	-	-	380,169	72.00
Boston, . . .	-	33,671	16,813	23,104	39,986	84,237	244	79,832	93,813	-	179,273	-	1,106,375	96,955	541,408	-	1,393,580	-	95,407	3,784,698	716.80
Somerville, . .	-	-	-	-	-	-	-	-	3,596	387	2,071	8,037	72,027	42,921	59,148	-	190,202	-	21,158	429,547	81.35
Malden, . . .	-	-	-	-	-	-	-	-	-	-	-	12,174	62,567	20,511	64,676	-	185,108	-	84,892	429,928	81.42
Chelsea, . . .	-	-	-	-	-	-	-	-	-	-	2,380	-	-	88,001	24,759	-	125,414	-	12,035	202,589	38.37
Quincy, . . .	-	-	-	-	-	-	-	-	2,679	-	19,813	-	21,230	28,384	77,435	994	182,875	948	88,085	422,443	80.01
Everett, . . .	-	-	-	-	-	-	-	2,484	2,900	-	2,233	206	5,570	32,847	19,840	-	115,924	-	36,047	218,051	41.30
Medford, . .	-	-	-	-	-	-	-	-	1,972	-	6,775	9,585	23,482	27,842	64,051	-	81,474	-	58,300	273,481	51.80
Melrose, . . .	-	-	-	-	-	-	-	-	-	-	5,200	2,920	14,586	5,022	16,814	-	97,981	-	90,513	232,536	44.04
Revere,* . . .	-	-	-	-	-	-	-	-	-	-	24,000	4,450	7,300	7,950	15,565	-	60,060	-	66,195	185,520	35.14
Watertown, . .	-	-	-	-	-	-	-	-	-	-	400	12,127	5,959	4,169	18,861	-	103,723	-	13,239	158,478	30.01
Winthrop,* . .	-	-	-	-	-	-	-	-	-	-	-	-	4,000	5,000	19,176	-	20,284	-	74,836	123,296	23.35
Belmont, . .	-	-	-	-	-	-	-	-	-	-	-	-	2,161	11,102	12,896	-	67,258	-	283	98,700	17.75
Nahant, . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	11,550	-	-	28,340	-	38,125	78,515	14.87
Arlington, . .	-	-	-	-	-	-	-	-	-	-	-	-	31,618	21,106	22,502	-	68,847	-	32,509	176,582	33.44
Swampscott, . .	-	-	-	-	-	-	-	-	-	-	-	-	9,472	12,247	16,694	-	42,863	-	11,558	92,834	17.58
Stoneham, . .	-	-	-	-	-	-	-	-	-	-	-	-	4,500	3,800	2,800	-	70,000	-	10,000	91,100	17.25
Total feet, .	307	157,834	24,888	23,104	86,498	111,144	244	128,920	161,741	387	296,129	49,525	1,384,998	369,937	1,007,514	994	2,835,173	948	733,182	7,373,467	-
Total miles, .	.06	29.89	4.71	4.38	16.38	21.05	.05	24.42	30.63	.07	56.09	9.38	262.31	70.06	190.82	.19	536.96	.18	138.86	-	1,396.49

* Pipes owned by Revere Water Company.

TABLE No. 44. — *Number of Service Pipes, Meters and Fire Hydrants in the Several Cities and Towns supplied by the Metropolitan Water Works.*

CITY OR TOWN.	Services.	Meters.	Fire Hydrants.
Boston,	88,647	4,473	7,700
Somerville,	10,520	224	927
Malden,	6,604	3,633	400
Chelsea,	6,198	113	263
Quincy,	4,480	147	576
Everett,	4,541	44	468
Medford,	3,967	114	460
Melrose,	3,177	82	266
Revere,	2,220	19	126
Watertown,	1,651	1,475	272
Winthrop,	1,663	4	104
Belmont,	599	599	140
Nahant,	446	16	57
Arlington,	1,675	73	333
Swampscott,	1,004	–	117
Stoneham,	1,148	14	70
Totals,	138,540	11,030	12,279

APPENDIX No. 4.

REPORT UPON OFFICIAL TESTS OF FOUR NEW PUMPING ENGINES AT THE CHESTNUT HILL LOW-SERVICE AND SPOT POND PUMPING STATIONS, MADE BY DEXTER BRACKETT, ENGINEER OF DISTRIBUTION DEPARTMENT, AND W. J. SANDO, M.E., REPRESENTING THE HOLLY MANUFACTURING COMPANY.

The official test of the three engines at the low-service station at Chestnut Hill was made on April 30 and May 1, and of the engine at Spot Pond on June 4 and 5.

Description of Pumping Plants.

The engines were designed and built by the Holly Manufacturing Company of Lockport, N. Y. They are all of the vertical triple expansion self-contained type, with pump plungers directly under the steam cylinders and rigidly connected with the steam pistons. The pumps are of a new design, each engine having three single acting outside packed plungers, and six suction and six delivery valve chambers.

The engines at the Chestnut Hill station are all made from the same patterns, and the Spot Pond engine is of the same general design, with larger steam cylinders and smaller pump plungers. The Chestnut Hill engines have each a capacity of 35,000,000 U. S. gallons in 24 hours against a head of 60 feet, and the Spot Pond engine has a capacity of 20,000,000 U. S. gallons against a head of 125 feet. All the engines have a stroke of 60 inches, those at Chestnut Hill being designed to make 30 revolutions and the engines at Spot Pond 25 revolutions per minute.

On the engines at the Chestnut Hill station the steam inlet and exhaust valves for the high and intermediate-pressure cylinders, and the inlet valves of the low-pressure cylinders, are of the Corliss type; the exhaust valves for the low-pressure cylinders are of the poppet type. At Spot Pond the exhaust valves for the intermediate-pressure cylinder and the inlet valves for the low-pressure cylinder are also of the poppet type. All valves receive their motion from a lay shaft which is driven from the crank shaft by means of bevelled gears. The cut-off on the high-pressure cylinder of each engine is controlled by an automatic centrifugal governor, and is also adjustable by hand. On the Chestnut Hill engines the cut-offs on both the intermediate and low-pressure cylinders are adjustable by hand. On the Spot Pond engine the cut-off on the intermediate-pressure cylinder can be so adjusted.

The cylinders are jacketed on barrels and heads. All valves are placed in the cylinder heads. There are receivers fitted with copper reheating coils between the high and intermediate-pressure cylinders and between the intermediate and low-pressure cylinders. The volumes are respectively 6¾ times and 2¾ times the volumes of the preceding cylinders.

The system of steam distribution through the jackets and receiver coils is as follows: The high-pressure jacket is supplied with steam from the main steam pipe at the same pressure as the steam at the throttle valve. The first receiver coil is supplied from the high-pressure jacket outlet, and the intermediate-pressure jacket is supplied at a reduced pressure from the first receiver coil outlet. The second receiver coil is supplied from the outlet of the intermediate-pressure jacket, and the low-pressure jacket from the outlet of the second receiver coil at a reduced pressure. The low-pressure jacket drain is trapped and discharged into the working side of the second receiver, and is then trapped to waste. The condensed water from the first and second receiver coils is discharged through ¼ inch pipes into the intermediate and low-pressure jackets. Each surface condenser at the Chestnut Hill station contains 725 square feet of cooling surface, and that at the Spot Pond station 785 square feet. The circulating water is taken from and returned to the suction main. Directly on top of each condenser there is an exhaust heater which contains 150 square feet of heating surface. The boiler feed pumps are attached to and driven by the main engines. An air compressor for charging the discharge air chambers is attached to and driven by each of the engines.

The engine bed-plates are supported upon the valve chamber castings, and also upon cast-iron columns. Each engine has two suction and two discharge pipes, and six valve chambers, three of which are located on either side of the centre line of the plunger chambers to which they are connected. The valve chambers are also connected longitudinally by the suction main at the bottom and the discharge main near the top. The valves are of rubber, 4 3/16 inches in diameter, and the area of the water way through each set of suction and discharge valves is 200 per cent. of the area of the pump plungers.

Steam at both stations is furnished by vertical fire-tube boilers designed by Dean & Main, M.E. At the Chestnut Hill station each boiler is 98 inches in diameter, 25 feet high, and contains 384 2-inch tubes 15 feet in length. At Spot Pond each boiler is 92 inches in diameter, 25 feet high, and contains 256 2¼-inch tubes 15 feet in length. At both stations the feed water, before entering the boilers, passes through a Green fuel economizer containing 144 tubes 4 9/16 inches in diameter and 9 feet long, around which the escaping gases from the boilers pass on the way to the chimney. The boilers at the Chestnut Hill station were built by the Atlantic Works of East Boston, and those at Spot Pond by the Lake Erie Boiler Works of Buffalo, N. Y.

Method of Conducting Trials.

The contracts provided that the engines should fulfil the following requirements: —

	Chestnut Hill Engines.	Spot Pond Engine.
Maximum plunger speed (feet per minute), ...	300	250
Capacity at maximum speed (U. S. gallons per 24 hours), . . .	35,000,000	20,000,000
Duty in foot-pounds per 1,000 pounds commercially dry steam, . .	145,000,000	150,000,000
Head to be pumped against (feet), ...	45	125
Steam pressure at throttle valve (pounds per square inch), . . .	150	150

The contracts also provided that the trials should be of 24 hours' duration; that the capacity of the engines should be determined by weir measurement, or some other method satisfactory to the conductors of the trials; that steam containing less than 1½ per cent. of entrained water, as determined by calorimeter measurement, should be considered as dry steam; and that in computing the duty the work performed by the engines should be based upon the displacement of the pump plungers.

The contract requirement for duty at both stations was based upon the quantity of steam used by the engines, and for this reason great care was taken to accurately determine the quantity used. At the Chestnut Hill station all of the boilers were used to supply steam to the engines, so that there was no question regarding leakage between the boilers. At the Spot Pond station a blank flange was placed in the connection between the boilers used during the trial and the remaining boiler, which was used to supply steam for the electric light engine and other purposes. At both stations all pipes from which there was a possibility of leakage were either closed by blank flanges or disconnected, so that any leakage could be discovered and measured. At the Chestnut Hill station a leakage test of the boilers and steam piping could not be made, on account of the necessity of continuously operating the machinery; but at the Spot Pond station a blank flange was placed in the main steam pipe near the engine, and a pressure of 150 pounds was maintained on the boilers, economizer and piping for 24 hours. At the end of that time a sufficient quantity of water was weighed and pumped into the boilers to bring the water level to the same elevation as it was at the beginning of the test, and it was found that the leakage was at the rate of 36 pounds per hour. At the

Chestnut Hill station the quantity of steam used by any one of the engines, as determined by the water fed to the boilers, could not be measured, because all the engines are supplied with steam from one main line of steam pipe, and it was absolutely necessary that at least two of the engines should be continually operated in order to maintain the supply of water to the Metropolitan District. For this reason all of the engines at this station were tested together.

The quantity of steam used by each engine was determined in the following manner: The condensed steam from the low-pressure cylinder was discharged by the air pump into a wrought-iron tank, from which it was drawn into a weighing tank. Another wrought-iron tank, resting on a platform scale, received the condensed steam from the low-pressure jacket. A wrought-iron tank received the condensed steam from the separators on all of the engines. The water from all of these tanks, after being carefully weighed, was discharged into a suction tank, from which it was forced into the boilers by the feed pumps attached to the engines. The supply to the boilers was regulated by means of a by-pass, through which the discharge from the feed pumps could be returned to the suction tank.

During the trial at the Chestnut Hill station the electric light and economizer engines were not operated, the light for the building being supplied from the plant at the high-service station. At the Spot Pond station steam for operating the lighting engine was supplied from a separate boiler, which was disconnected from the boilers supplying steam to the engine tested.

At both stations the steam pressure at the engine was determined by a mercurial gage connected at the engine throttle valve. The vacuum in the condenser was also determined by a mercurial gage, and readings of both steam and vacuum gages were taken every 20 minutes of the trial at the Chestnut Hill station, and every 15 minutes at the Spot Pond station. The elevation of the water in each of the pump wells was determined from readings of float gages taken every 15 minutes during the test. The pressure of water in the force mains was determined from the average of readings taken every 5 minutes on the mercurial gages connected with the force mains of each engine. The revolutions of the engines were observed every 20 minutes at Chestnut Hill and every 15 minutes at Spot Pond.

The condensed steam discharged by each of the air pumps was weighed every 20 minutes at Chestnut Hill and every 15 minutes at Spot Pond. The condensed steam from the low-pressure jacket drains was weighed every 60 minutes at Chestnut Hill and every 30 minutes at Spot Pond. The discharge from the separator drains was weighed each hour at both stations. Observations were made and recorded each hour during the trial at each station of the steam pressure in the receivers between the steam cylinders; the temperature of steam at the throttle valve at the inlet of each steam cylinder and at the low-pressure exhaust of all the engines;

the temperatures of water in the drains from the low-pressure jackets; temperatures of water discharged from the air pumps, of water entering and leaving the condensers, of water in the several weighing tanks and of air in the engine and boiler rooms. In the boiler room records were made of the weight of coal fed to each boiler during every hour. The level of the water in each boiler, the steam pressures in the boilers, the amount of draft, the temperature of the feed water and of the flue gases entering and leaving the economizer, and the counter of the water meter on the boiler feed pipe were observed and recorded each hour. A sample of the flue gases was taken and analyzed each hour during both trials.

At both stations the condition of the fires at the beginning and end of the tests was as nearly the same as could be determined by the careful inspection of three persons, and the recorded weight very closely represents the actual quantity burned during the 24 hours.

All scales for weighing water and coal were tested and sealed immediately before each trial. All indicator springs were tested and calibrated immediately after each trial, and all pump valves were examined and tested for leakage and found to be practically tight.

Indicator diagrams from all the steam cylinders were taken every hour. The indicators on all the steam cylinders of each engine were electrically connected in such manner that six diagrams were taken simultaneously from each engine, each of which represented the average pressure in the cylinder for 1 minute. The pencil friction of the indicator was prevented by a current breaker which gave the pencil an intermittent instead of a constant contact with the paper, and formed the diagram by a series of dots. At the Chestnut Hill station the pencil made 30 revolutions on each diagram and at the Spot Pond station 25 revolutions, so that each diagram represents the average pressure in the cylinder for 1 minute.

While the indicator diagrams were being taken, 5-second observations were made of the pressure in the force mains, and from these observations the actual horse-power of work done by each engine while the diagrams were being made was determined.

The average friction of each engine for the 24 hours of the trial was determined from the average of the differences between indicated horse-power and the actual horse-power of work done during times while the diagrams were being taken.

Calorimeter measurements of the quality of the steam were made during both trials.

The coal used at the Chestnut Hill station was the Loyal Hanna Sonman Shaft coal, and at the Spot Pond station Georges Creek Cumberland coal, — in both cases the coal in regular use at the stations. The number of thermal units per pound of coal was not actually determined, and the quantities used in the report are those determined for the same kind of coal on previous tests.

In connection with the test of the engine at the Spot Pond station a careful weir measurement was made of the water pumped. The water pumped by the engine was forced through a 36-inch pipe to a distributing reservoir, where it was delivered into a masonry chamber 20.5 feet long, 6 feet wide and 18.25 feet deep. The water entered the side of the chamber at the bottom near one end, passed through a screen, and then, after flowing 13 feet through the chamber, passed over a weir 5.991 feet long, having a brass edge 0.25 of an inch wide, finished perfectly level. A temporary floor was placed in the chamber between the screen and the weir, making the channel approaching the weir 6 feet in depth. A rectangular brass plate, 8 inches long by 6 inches high, with a hole 1 1/16 inches in diameter in the centre, was set flush with the side of the channel, with centre of the hole 6 feet back from the weir and .790 of a foot below the crest. The hole in the center of the plate was connected by a 1-inch pipe with a can in which the water level was observed every 2 minutes during the entire 24 hours. The quantity delivered was determined by three different formulæ, and the average result used. The leakage from the force main was tested before the trial.

At the Chestnut Hill station no measurement of the slip of the pumps was made during the trial, but the monthly records of water pumped at the station compared with careful current meter measurements of the water delivered to the pumps show that the slip does not exceed 1¼ per cent.

Principal Dimensions of Engines.

		LOW-SERVICE ENGINES.			Northern High-service Engine Number 9.
		Number 5.	Number 6.	Number 7.	
1	Diameter H. P. cylinder (nominal) (inches),	17	17	17	22
2	Diameter I. P. cylinder (nominal) (inches), .	31.25	31.25	31.25	41.5
3	Diameter L. P. cylinder (nominal) (inches),	48	48	48	62
	Cylinder Clearances.				
4	High pressure (per cent), ...	-	1.5	-	1
5	Intermediate pressure, (per cent.), . . .	-	1.3	-	.5
6	Low pressure (per cent.), ...	-	1.1	-	.5
7	Diameter of plungers (nominal) (inches), .	37	37	37	30.5
8	Stroke of pistons and plungers (nominal) (inches).	60	60	60	60
9	Diameter of suction and discharge pipes (inches).	36	36	36	30
10	Diameter of fly wheels (2) (feet), . . .	17	17	17	17
11	Weight of each wheel (pounds), . . .	30,000	30,000	30,000	34,000
12	Revolutions per minute for capacity, . .	29.01	29.01	29.01	24.4
13	Speed per minute (feet), ...	290.1	290.1	290.1	244.0

Principal Dimensions of Boiler Plant.

		Low-service Pumping Station (3 Boilers).	Northern High-service Pumping Station.
14	Number of boilers used during test,	3	2
15	Boiler diameter (feet),	8.17	7.67
16	Boiler length (over all) (feet),	29.5	29.37
17	Number of tubes in each boiler,	384	256
18	Diameter of tubes, outside (inches),	2	2.25
19	Length of tubes (feet),	15	15
20	Water heating surface, each boiler (square feet),	2,107	1,645
21	Super heating surface, each boiler (square feet),	832	650
22	Total heating surface, each boiler (square feet),	2,939	2,295
23	Inside area of tubes, each boiler (square feet),	6.82	5.89
24	Grate diameter (feet),	7	6.5
25	Grate area, each boiler (square feet),	38.48	33.18
26	Ratio of water heating to grate surface,	56.57 to 1	49.58 to 1
27	Ratio of total heating to grate surface,	76.38 to 1	69.17 to 1
28	Ratio of grate to inside area of tubes,	5.64 to 1	5.63 to 1
29	Economizer heating surface outside of tubes (square feet),	1,728	1,728
30	Height of stack (feet),	125	125
31	Inside diameter of stack (feet),	4.5	4.5

Trial Data and Results.

		Low-service Engines.			Northern High-service Engine Number 9.
		Number 5.	Number 6.	Number 7.	
32	Date of trial,	-*	-*	-*	-†
33	Duration of trial,	24 hrs.	24 hrs.	24 hrs.	24 hrs.

* 10 A.M April 30 to 10 A.M. May 1, 1901. † 10 A.M. June 4 to 10 A.M. June 5, 1901.

Average Pressures.

		Number 5.	Number 6.	Number 7.	Number 9.
34	Steam at boilers (pounds),	-	153.71	-	151.03
35	Steam at throttle (mercurial gage) (pounds),	-	150.88	-	150.39
36	1st receiver (pounds),	25.01	24.48	24.79	23.41
37	2d receiver (pounds),	—5.95	—4.75	—5.25	—3.58
38	Vacuum (pounds per square inch),	13.49	13.42	13.67	13.20
39	Barometer (pounds per square inch),	14.65	14.65	14.65	14.58
40	H. P. jacket (pounds),	-	150.88	-	150.39
41	I. P. jacket (pounds),	-	40.00	-	40.21
42	L. P. jacket (pounds),	-	3.10	-	2.6
43	Draft in flue at economizer outlet (inches of water).	-	-	-	0.109
44	Draft in flue at end of boiler, economizer inlet (inches of water).	-	0.142	-	0.2425

Average Temperatures, Degrees Fahrenheit.

		LOW-SERVICE ENGINES.			Northern High-service Engine Number 9.
		Number 5.	Number 6.	Number 7.	
45	Steam at boiler due to pressure, . . .	-	367.5	-	366.18
46	Steam at throttle due to pressure, . . .	-	366.14	-	365.87
47	Steam entering H. P. cylinder, . . .	363.6	362.4	365.8	364.57
48	Steam entering I. P. cylinder, ...	268.5	266.1	268.2	266.31
49	Steam entering L. P. cylinder, . . .	197.1	195.5	193.6	201.72
50	Water from L. P. jacket, ...	177.2	187.1	186.5	199.5
51	Water discharged from air pump, . . .	97.0	100.6	91.5	106.4
52	Water entering economizer, ...	-	85.0	-	92.82
53	Water leaving economizer (fed to boiler), .	-	121.2	-	157.90
54	Water condenser circulating inlet (water pumped).	-	48.2	-	58.86
55	Flue gases leaving boiler, ...	-	412.0	-	437.0
56	Flue gases leaving economizer, . . .	-	227.3	-	230.6

Head Pumped Against.

57	Average elevation of water in force main above Boston city base (feet).	178.063	178.060	177.06	286.845
58	Average elevation of water in wet well above Boston city base (feet).	132.97	133.088	133.06	161.57
59	Average net head pumped against (feet), .	45.093	44.972	44.00	125.275

Revolutions.

60	Total revolutions during 24 hours, . . .	43,292	43,287	43,290	35,789
61	Average revolutions per minute, . . .	30.0639	30.0604	30.0625	24.853

Useful Work performed by Engine.

62	Total water pumped (no allowance for slip) (U. S. gallons).	36,284,300	36,268,900	36,280,000	20,896,800

Water fed to Boiler.

63	Total water fed to boilers (pounds), . .	-	264,568	-	125,211

Steam out of Boilers not used by Engine.

		Low-service Engines.			Northern High-service Engine Number 9.
		Number 5.	Number 6.	Number 7.	
64	Water from separator (pounds), . . .	-	329	-	217
65	Steam blown through calorimeter (weighed in tank) (pounds).	-	352.4	-	647
66	Leakage from whole plant, exclusive of engines (pounds).	-	4,115.7	-	769
67	Discharge from oil-pressure pipe (pounds), .	-	1,885.4	-	-
68	Total steam from boilers not used by engines (pounds).	-	6,682.5	-	1,633
69	Steam chargeable to engines (pounds), . .	-	257,885.5	-	123,578

Steam received from Engine.

70	From condenser (pounds), ...	75,280	76,353	72,968	106,345
71	From leak on engine caught and weighed (pounds).	-	58	-	-
72	From L. P. jacket (pounds), ...	10,806.5	11,491	10,929	16,220.5
73	From second receiver (pounds), . . .	-	-	-	603.5
74	Charged to leaks on engine, ...	-	-	-	409
75	Total steam used by engines, ...	86,086.5	87,902	83,897	123,578
76	Average entrainment in steam entering engine at Sp. Pd. (0.7 of 1 p. c.).	-	-	-	865
77	Total dry steam used by engines, . . .	-	257,885.5	-	122,713
78	Percentage of total steam used in jackets, .	12.55	13.07	13.03	13.125

British Thermal Units.

79	Total heat used by engine, B. T. U., . .	96,288,690	97,892,510	94,104,780	136,056,540
80	Heat contained in one pound of wet coal, B. T. U.	14,023	14,023	14,023	14,110

Horse-power Figures.

81	Average percentage of friction of engine (average of 24 sets of cards).	11.16	11.58	12.57	3.47
82	Average delivered horse-power (useful work),	287.27	286.38	280.27	448.35
83	Average indicated horse-power, H. P. cylinder,	114.11	112.58	111.11	151.93
84	Average indicated horse-power, I. P. cylinder,	104.09	104.10	103.80	138.22
85	Average indicated horse-power, L. P. cylinder,	105.16	107.20	105.66	174.32
86	Total indicated horse-power, ...	323.36	323.88	320.57	464.47
87	Average moist steam per I. H. P. per hour (pounds).	-	11.10	-	11.09
88	Average dry steam per I. H. P. per hour (pounds).	11.08	11.31	10.92	11.01
89	Average B. T. U. per I. H. P. per minute, .	206.79	209.90	203.86	203.42

Coal and Rate of Combustion and Evaporation.

		LOW-SERVICE ENGINES.			Northern High-service Engine Number 9.
		Number 5.	Number 6.	Number 7.	
90	Total moist coal burned in 24 hours (pounds),	-	26,542	-	12,432
91	Percentage of moisture in coal, . . .	-	2.2	-	3.7
92	Total dry coal burned during test (pounds),	-	25,958	-	11,972
93	Total ashes during test (pounds), . . .	-	1,648	-	783
94	Total combustible during test (pounds), .	-	24,310	-	11,189
95	Moist coal burned per square foot of grate surface per hour (pounds).	-	9.58	-	7.806
96	Moist coal burned per square foot of water heating surface per hour (pounds).	-	0.175	-	0.1574
97	Evaporation per pound of moist coal, actual conditions, including economizer (pounds).	-	9.968	-	10.072
98	Evaporation per pound of dry coal, actual conditions, including economizer (pounds).	-	10.192	-	10.459
99	Evaporation per pound of dry coal, from and at 212° F., including economizer (pounds).	-	12.042	-	12.270
100	Evaporation per pound of dry coal, from and at 212° F., excluding economizer (pounds).	-	11.677	-	11.593
101	Evaporation per square foot of water heating surface per hour (pounds).	-	1.744	-	1.586
102	Moist coal per I. H. P. per hour (pounds), .	-	1.143	-	1.115
103	Dry coal per I. H. P. per hour (pounds), .	-	1.118	-	1.074
104	Kind of coal, ...	-*	-*	-*	-†

* Loyal Hanna Sonman Shaft. † Georges Creek Cumberland.

Duties.

105	Duty per 1,000 pounds steam, contract basis (foot-pounds).	158,574,000	154,815,000	158,750,000	172,405,000
106	Duty per 1,000,000 B. T. U. (foot-pounds), .	141,787,000	139,039,000	143,771,000	156,592,000
107	Duty per 100 pounds moist coal (foot-pounds),	-*	-*	-*	171,876,000
108	Duty per 100 pounds dry coal (foot-pounds),	-†	-†	-†	177,961,000
109	Duty per 1,000 pounds dry steam, . . .	-‡	-‡	-‡	178,620,000

* Average 3 engines, 152,883,000. † Average 3 engines, 156,322,000. ‡ Average 3 engines, 157,349,000.

Efficiencies.

110	Efficiency of mechanism (per cent.), . .	88.84	88.42	87.43	96.53
111	Efficiency of boilers and economizer, actual (per cent.).	-	82.9	-	84.64
112	Efficiency of boilers alone, actual if economizer had not been used (per cent.).	-	80.4	-	79.97
113	Thermal efficiency of engine (per cent.), .	20.50	20.22	20.80	20.85

Weir Measurements.

		LOW-SERVICE ENGINES.			Northern High-service Engine Number 9.
		Number 5.	Number 6.	Number 7.	
114	Length of weir (feet),	-	-	-	5.991
115	Average depth of water on weir (feet),	-	-	-	1.337
116	Calculated discharge over weir (gallons),	-	-	-	20,142,500
117	Leakage from force main during test (gallons),	-	-	-	1,120
118	Water drawn from force main during test (gallons).	-	-	-	4,080
119	Plunger displacement of pumps (gallons),	-	-	-	20,396,800
120	Slip (per cent.),	-	-	-	1.22

APPENDIX No. 5.

SUMMARY OF STATISTICS FOR THE YEAR 1901.

The Metropolitan Water Works supply the Metropolitan Water District, which includes the following cities and towns: —

CITIES AND TOWNS.	Population, Census of 1900.	Estimated Population, May 1, 1901.
Boston,	560,892	573,200
Somerville,	61,643	63,600
Chelsea,	34,072	34,700
Malden,	33,664	34,700
Newton,*	33,587	34,900
Everett,	24,336	25,500
Quincy,	23,899	24,900
Medford,	18,244	19,100
Hyde Park,*	13,244	13,600
Melrose,	12,962	13,300
Revere,	10,395	11,200
Watertown,	9,706	10,100
Arlington,	8,603	9,000
Stoneham,	6,197	6,300
Winthrop,	6,058	6,500
Belmont,	3,929	4,200
Nahant,	1,152	1,200
Total population of Metropolitan Water District,	862,583	886,000
Swampscott,†	4,548	4,700

* No water supplied to these places during the year from Metropolitan Water Works.

† Swampscott is not in the Metropolitan Water District, but has been supplied with water from the Metropolitan Water Works.

Sources of Supply.

SOURCE.	Area of Watershed (Square Miles).	Remarks.
Lake Cochituate,	18.87	Works built by city of Boston in 1848.
Sudbury River,	75.20	Works built by city of Boston in 1872-78.
Nashua River,	118.23	Works begun in 1895; not finished.

Mode of Supply.

Pumping to reservoirs.

Pumping.

Chestnut Hill High-service Station: —

Builders of pumping machinery, Holly Manufacturing Company, Quintard Iron Works and E. P. Allis Company.

Description of coal used: Bituminous; Georges Creek Cumberland and Loyal Hanna Sonman Shaft; anthracite coal screenings. Price per gross ton in bins: $4.29 to $4.78; screenings, $2.24 to $2.80. Average price per gross ton, $4.29. Per cent. ashes, 9.6.

Chestnut Hill Low-service Station: —

Builders of pumping machinery, Holly Manufacturing Company.

Description of coal used: Bituminous; Loyal Hanna Sonman Shaft. Price per gross ton in bins, $4.29 to $4.78. Average price per gross ton, $4.44. Per cent. ashes, 8.9.

Spot Pond Station: —

Builders of pumping machinery, Geo. F. Blake Manufacturing Company and Holly Manufacturing Company.

Description of coal used: Bituminous; Georges Creek Cumberland; anthracite coal screenings. Price per gross ton in bins, $4.37 to $4.48; screenings, $2.24. Average price per gross ton, $4.41. Per cent. ashes, 9.7.

	CHESTNUT HILL HIGH-SERVICE STATION.				
	Engines Nos. 1 and 2.	Engines Nos. 1 and 2 (Low-service).	Engine No. 3.	Engine No. 3 (Low-service).	Engine No. 4.
Coal consumed for year (pounds), . .	499,756	310,069	953,488	482,009	6,346,061
Cost of pumping, figured on pumping station expenses.	$2,152.56	$1,946.59	$4,486.79	$2,427.15	$27,193.97
Total pumpage for year (million gallons),	202.47	204.51	1,016.57	645.58	8,584.11
Average dynamic head, ...	124.33	48.13	125.25	67.77	126.31
Gallons pumped per pound of coal, . .	608.18	1,077.18	1,102.38	1,478.94	1,352.67
Duty, on basis of plunger displacement, .	65,760,000	45,090,000	118,600,000	86,090,000	144,450,000
Cost per million gallons raised to reservoir,	$10.632	$9.518	$4.364	$3.760	$3.168
Cost per million gallons raised one foot, .	.086	.198	.035	.055	.025

	CHESTNUT HILL LOW-SERVICE STATION.	SPOT POND STATION.	
	Engines Nos. 5, 6 and 7.	Engine No. 8.	Engine No. 9.
Coal consumed for year (pounds), ...	8,528,670	344,975	2,076,021
Cost of pumping, figured on pumping station expenses, .	$39,587.97	$1,917.93	$11,463.13
Total pumpage for year (million gallons), ...	26,354.40	351.89	2,414.53
Average dynamic head, ...	48.37	114.54	119.50
Gallons pumped per pound of coal, ...	3,090.09	1,020.04	1,163.06
Duty on basis of plunger displacement, ...	126,420,000	99,320,000	117,700,000
Cost per million gallons raised to reservoir, ...	$1.502	$5.450	$4.748
Cost per million gallons raised one foot, ...	.031	.048	.040

Consumption.

Estimated total population of the sixteen cities and towns supplied wholly or partially during the year 1901, . . .	844,800
Total consumption, gallons, ...	37,044,840,000
Furnished from Metropolitan Water Works sources, gallons, .	36,830,240,000
Furnished from local sources, gallons, ...	214,600,000
Average daily consumption, gallons, ...	101,492,000
Gallons per day each inhabitant, ...	120.1

Distribution.

	Owned and operated by Metropolitan Water and Sewerage Board.	Total in District supplied by Metropolitan Water Works.
Kind of pipe used, ...	-*	-†
Sizes, ...	60 to 6 inch.	60 to 4 inch.
Extension less length abandoned, miles, ...	2.18	36.17
Length in use, miles, ...	72.00	1,396.5
Stop gates added, ...	12	-
Stop gates now in use, ...	280	-
Service pipes added, ...	-	4,044
Service pipes now in use, ...	-	138,540
Meters added, ...	-	645
Meters now in use, ...	-	11,030
Fire hydrants added, ...	-	366
Fire hydrants now in use, ...	-	12,279

* Cast-iron and cement-lined wrought iron. † Cast-iron, cement-lined wrought iron and kalamine.

APPENDIX No. 6.

COMMONWEALTH OF MASSACHUSETTS.

SUFFOLK, ss. SUPREME JUDICIAL COURT IN EQUITY.

JAMES A. BAILEY AND OTHERS, METROPOLITAN SEWERAGE COMMISSIONERS, PETITIONERS, *in re* THE NORTH METROPOLITAN SYSTEM OF SEWERAGE.

REPORT AND AWARD OF COMMISSIONERS.

The North Metropolitan System of Sewerage originally included a portion of the city of Boston, the cities of Cambridge, Somerville, Malden, Chelsea, Woburn, Melrose, Medford and Everett, and the towns of Stoneham, Winchester, Arlington, Belmont and Winthrop.

Under the provisions of chapter 414, Acts of the year 1896, and of chapter 172, Acts of the year 1900, the town of Wakefield was included in this system. Under the provisions of chapter 520, Acts of the year 1897, "the territory comprising the villages of Centre and East Lexington in the town of Lexington" was added to the district.

In May, 1891, Ebenezer R. Hoar, William C. Endicott and John E. Sanford were appointed, under decree of this court, commissioners to determine the proportions which the several cities and towns included in the North Metropolitan and Charles River systems should, for the first term of five years, namely, from 1891 to 1895, inclusive, annually pay money into the treasury of the Commonwealth to meet the interest and sinking fund requirements for each year, and to meet the cost of maintenance and operation for each year.

In October, 1895, Edmund H. Bennett, John E. Sanford and Everett C. Bumpus were appointed, under a decree of this court, to make a similar apportionment for those systems for the second term of five years, namely, from 1896 to 1900, inclusive.

Under the provisions of chapter 424, Acts of the year 1899, the Charles River System was made a part of the South Metropolitan System of Sewerage.

Under decree of this court, dated May 16, 1901, the undersigned were appointed commissioners to make the apportionment for the North Metropolitan Sewerage System for a third term of five years, namely, from 1901 to 1905, inclusive.

Acting under the authority thus granted and in the performance of the duty thus imposed, several hearings have been given, after due notice to all parties in interest in the matter submitted to our decision. These hearings were held at the rooms of the Railroad Commission, 20 Beacon Street, Boston, upon the twentieth day of June, the first, ninth and thirtieth days of July and the fifth day of August in this year.

From the statement of the Treasurer and Receiver-General of the Commonwealth, it appears that, to meet the necessary payments into the treasury of the Commonwealth on account of the North Metropolitan System of Sewerage for the current year, there is required for sinking fund $46,385.79 ; for interest, $169,325 ; and for cost of maintenance and operation, in accordance with legislative appropriation, $76,500. We understand that this appropriation for cost of maintenance and operation was less than it otherwise would have been for the reason that there were available unexpended balances of former appropriations amounting to about $20,000.

In the language of the statute, the apportionment of these expenses is to be made in such manner as the commissioners "shall deem just and equitable." We have been urged by the representatives of several municipalities to adopt a different method of distribution than that followed by the commissioners who have previously made the apportionment; but the weight of opinion expressed at the hearings was very clearly in favor of continuing the methods hitherto adopted, and in our judgment, particularly in view of precedent, the weight of argument demands such course. Accordingly, we have made an apportionment of the payments necessary to meet the interest and sinking fund requirements upon the basis of property valuation, as established by chapter 198, Acts of the year 1901 ; and the apportionment of the payments required to meet the annual cost of maintenance and operation upon the basis of population, as determined by the United States census of 1900, using the proportionate part of such valuation and population in the case of any city or town a part of which only is included in the district.

We are satisfied that the plan adopted accomplishes substantial justice in the distribution of the burden in accordance with benefits received.

It was contended on the part of several municipalities that local conditions, particularly the character of the watersheds in these cities and towns, were such as to prevent them from receiving the full benefit of the system, and that they were entitled to have consideration given to this fact. The evidence presented, however, failed to convince us that in any instance it was physically impracticable to make use of the system, and, on the whole, tended to show that these cities and towns received such benefit as to warrant an assessment upon them under the rule above stated.

Interest and Sinking Fund.

The commissioners appointed by this court in 1895 considered the amount of contribution which the town of Wakefield ought to make toward the cost of construction previous to the addition to the district of that portion of the town which was annexed to it by chapter 414, Acts of the year 1896. The Board of Metropolitan Sewerage Commissioners determined the amount of contribution which the town of Lexington ought to make toward the cost of construction previous to the addition to the district of a portion of the town by chapter 520, Acts of the year 1897. We have given consideration in this proceeding to the fact that the town of Wakefield in respect to that portion of the town made a part of this district by chapter 172 of the Acts of the year 1900 has not fully contributed to the previous cost of construction.

We therefore determine as just and equitable that the several cities and towns in the North Metropolitan System of Sewerage shall annually pay money into the treasury of the Commonwealth for a term of five years, viz., 1901 to 1905, both inclusive, to meet interest and sinking fund requirements for each of said years, as estimated by the State Treasurer, of that portion of the Metropolitan Sewerage Loan authorized and issued for the construction of said system, and any deficiency in the amount previously paid in, as found by the said Treasurer, in the proportions set down in the following table: —

Table showing Proportions in Percentages in which the Several Cities and Towns in the North Metropolitan System shall pay Money into the Treasury of the Commonwealth, to meet Interest and Sinking Fund Requirements under the Provisions of the Statutes relating thereto.

CITY OR TOWN.	Proportion.	CITY OR TOWN.	Proportion.
Arlington,	2.39	Melrose,	3.41
Belmont,	1.50	Somerville,	13.87
Boston,*	16.89	Stoneham,	1.35
Cambridge,	25.75	Wakefield,	2.35
Chelsea,	6.20	Winchester,	2.41
Everett,	4.81	Winthrop,	1.81
Lexington,†	.90	Woburn,	2.80
Malden,	8.16		
Medford,	5.40	Total,	100.00

* East Boston and Charlestown districts.

† Villages of Centre and East Lexington.

Maintenance and Operation.

The towns of Lexington and Wakefield have not as yet connected any local sewers with the Metropolitan System. It was contended by counsel that, until such connection has been made, these towns are exempt from assessment for any part of the cost of maintenance and operation under the provisions of section 10, chapter 520, Acts of the year 1897, relating to Lexington, and section 7, chapter 172, Acts of the year 1900, relating to Wakefield. We are of the opinion, however, that the exemptions named in those statutes are binding only upon the Board of Metropolitan Sewerage Commissioners in making their annual apportionment, and do not limit our authority or control us in our duty in dealing with these towns. It was further contended that if, as a matter of law, these exemptions did not apply in this proceeding, through them the Legislature had declared a rule of equity which ought to govern us in making the apportionment. We cannot fully accept this proposition, as it seems to us that the territorial character of the district and benefits received and to be received justify the assessment upon each town of some portion of the expense of maintenance and operation, as well as of the construction of the system. The system is complete and ready for connection with local sewers in these towns. In Wakefield the work of effecting such connection is well under way, and will undoubtedly be finished within a comparatively short time. There appears to be no reason why the town of Lexington cannot readily within the next five years connect local sewers with the system. We have given what we believe to be due consideration to these facts and to all the conditions affecting these towns in making the following table of proportions.

We therefore determine as just and equitable that the several cities and towns in the North Metropolitan System of Sewerage shall annually pay money into the treasury of the Commonwealth for the term of five years, viz., 1901 to 1905, both inclusive, to meet the cost of maintenance and operation of said system for each of said years as estimated by the Metropolitan Water and Sewerage Board (the successor of the Board of Metropolitan Sewerage Commissioners) and certified to said Treasurer, and any deficiency in the amount previously paid in as found by said treasurer in the proportions set down in the following table: —

Table showing Proportions in Percentages in which the Several Cities and Towns in the North Metropolitan System shall pay Money into the Treasury of the Commonwealth, to meet the Cost of Maintenance and Operation, under the Provisions of the Statutes relating thereto.

CITY OR TOWN.	Proportions.	CITY OR TOWN.	Proportions.
Arlington,	2.06	Melrose,	3.10
Belmont,	.94	Somerville,	14.74
Boston,*	20.66	Stoneham,	1.48
Cambridge,	21.96	Wakefield,	1.78
Chelsea,	8.14	Winchester,	1.73
Everett,	5.82	Winthrop,	1.45
Lexington,†	.32	Woburn,	3.41
Malden,	8.05		
Medford,	4.36	Total,	100.00

East Boston and Charlestown districts. † Villages of Centre and East Lexington.

(Signed) JAMES F. JACKSON,
LARKIN T. TRULL,
ARTHUR P. RUGG,
Commissioners.

AUGUST 5, 1901.

APPENDIX No. 7.

LEGISLATION OF THE YEAR 1901 AFFECTING THE METROPOLITAN WATER AND SEWERAGE BOARD.

ACTS.

[CHAPTER 30.]

AN ACT MAKING AN APPROPRIATION FOR OPERATING THE SOUTH METROPOLITAN SYSTEM OF SEWAGE DISPOSAL.

Be it enacted, etc., as follows:

South metropolitan system of sewage disposal.

SECTION 1. A sum not exceeding seventy thousand five hundred and sixty dollars is hereby appropriated, to be paid out of the treasury of the Commonwealth from the ordinary revenue, for the cost of maintenance and operation of the south metropolitan system of sewage disposal, comprising a part of the city of Boston, the cities of Quincy, Newton and Waltham, and the towns of Brookline, Watertown, Dedham, Hyde Park and Milton.

SECTION 2. This act shall take effect upon its passage. [*Approved February 6, 1901.*

[CHAPTER 40.]

AN ACT MAKING AN APPROPRIATION FOR OPERATING THE NORTH METROPOLITAN SYSTEM OF SEWERAGE.

Be it enacted, etc., as follows:

North metropolitan system of sewage disposal.

SECTION 1. A sum not exceeding seventy-six thousand five hundred dollars is hereby appropriated, to be paid out of the treasury of the Commonwealth from the ordinary revenue, for the maintenance and operation of the system of sewage disposal for the cities of Boston, Cambridge, Somerville, Malden, Chelsea, Woburn, Medford, Melrose and Everett, and the towns of Stoneham, Winchester, Arlington and Belmont, known as the North Metropolitan System, during the year ending on the thirty-first day of December, nineteen hundred and one.

SECTION 2. This act shall take effect upon its passage. [*Approved February 12, 1901.*

[CHAPTER 104.]

AN ACT TO PROVIDE FOR EXAMINATION BY THE STATE BOARD OF HEALTH OF THE OUTLETS OF SEWERS, AND AS TO THE EFFECT OF SEWAGE DISPOSAL.

Be it enacted, etc., as follows:

State board of health to examine outlets of sewers, etc.

SECTION 1. The state board of health shall annually examine all main outlets of sewers and drainage of the cities and towns of the Commonwealth, and the effect of sewage disposal, and annually report thereon to the general court, with such recommendations for the protection of the interests of persons and property as said board shall deem expedient, and for the prevention of offensive odors and objectionable conditions.

SECTION 2. This act shall take effect upon its passage. [*Approved March 5, 1901.*

[CHAPTER 168.]

AN ACT TO CONSOLIDATE THE METROPOLITAN WATER BOARD AND THE BOARD OF METROPOLITAN SEWERAGE COMMISSIONERS.

Be it enacted, etc., as follows:

Metropolitan Water and Sewerage Board created.

SECTION 1. A board is hereby created which shall be known as the Metropolitan Water and Sewerage Board, and shall consist of three members, who shall be appointed by the governor with the advice and consent of the council.

Term of office of members, etc.

SECTION 2. The term of office of the members of said board shall be three years, beginning from the date of their appointment, but of the members first appointed one shall be appointed for the term of five years, one for the term of four years and one for the term of three years from said date of appointment.

Chairman, etc.

The governor shall designate one of the members of said board as chairman, and shall also designate the term for which each member is appointed.

Compensation.

SECTION 3. The chairman of said board shall receive a salary of five thousand dollars a year, and each of the other members shall receive a salary of forty-five hundred dollars a year.

Removals, vacancies.

SECTION 4. The governor shall have power to remove any member of said board, with the advice and consent of the council, and to fill all vacancies therein, by appointing for the remainder of any unexpired term in the same manner in which appointments are authorized for a full term.

The metropolitan water board and board of metropolitan sewerage commissioners abolished, etc.

SECTION 5. The metropolitan water board and the board of metropolitan sewerage commissioners are hereby abolished. All the powers, rights, duties and liabilities of said metropolitan water board and of said board of metropolitan sewerage commissioners, and of each of them, are hereby transferred to the Metropolitan Water and Sewerage Board created by this act.

Existing contracts, etc., not affected.

No existing contracts, liabilities or suits shall be affected hereby, but the board hereby created shall in all respects and for all purposes whatsoever be the lawful successor of said metropolitan water board and of said board of metropolitan sewerage commissioners.

SECTION 6. This act shall take effect upon its passage. [*Approved March 20, 1901.*

[CHAPTER 204.]

AN ACT TO PROVIDE ADDITIONAL SEWERAGE FACILITIES FOR THE CITY OF NEWTON AND THE TOWN OF BROOKLINE.

Be it enacted, etc., as follows:

Metropolitan sewer to be extended.

SECTION 1. The metropolitan water and sewerage board shall extend the metropolitan sewer from a branch in St. Joseph's cemetery in West Roxbury to and across the boundary line between Newton and Brookline, in the manner best adapted to serve the sewerage needs of those municipalities.

Newton and Brookline, etc., may make connections with sewers.

SECTION 2. The city of Newton and the town of Brookline, and any persons and corporations, may, subject to the control and under the direction of the said board, make connections with any sewers constructed by the board under the authority of this act.

The metropolitan water and sewerage board to exercise certain authority, etc.

SECTION 3. In making said extension and in receiving sewage from said districts, and in any action relating thereto, and for the purpose of constructing and maintaining said additional main lines of sewer, the said board, acting on behalf of the Commonwealth, shall have and exercise all the authority conferred by chapter four hundred and thirty-nine of the acts of the year eighteen hundred and eighty-nine, by chapter four hundred and six of the acts of the year eighteen hundred and ninety-five, and by acts in amendment thereof and in addition thereto regarding the original system or anything relating thereto, and by chapter one hundred and sixty-eight of the acts of the year nineteen hundred and one; and all the provisions of said chapters are hereby made applicable to this additional construction, except as herein otherwise provided.

Metropolitan Sewerage Loan.

SECTION 4. To meet the expenses incurred under the provisions of this act the treasurer and receiver general shall, with the approval of the governor and council, issue scrip or certificates of debt, in the name and behalf of the Commonwealth and under its seal, to an amount not exceeding forty thousand dollars, for a term not exceeding forty years. Such scrip or certificates of debt shall be issued as registered bonds or with interest coupons attached, and shall bear interest at a rate not exceeding four per cent per annum, payable semi-annually on the first days of March and September in each year. The said interest and scrip or certificates shall be payable and when due shall be paid in gold coin or its equivalent. Said scrip or certificates of debt shall be designated on their face, Metropolitan Sewerage Loan, shall be countersigned by the governor, and shall be deemed a pledge of the faith and credit of the Commonwealth, redeemable at the time specified therein, in gold coin or its equivalent, and shall be sold or disposed of at public auction or in such other mode and at such times and prices and in such amounts and at such rate of interest, not exceeding four per cent per annum, as the treasurer and receiver general with the approval of the governor and council shall deem for the best interests of the Commonwealth. Any scrip or certificates of debt issued under the provisions of this act shall be considered as an addition to and shall become a part of the loan authorized by chapter four hundred and six of the acts of the year eighteen hundred and ninety-five and acts in amendment thereof and in addition thereto.

Payment of loan, etc.

SECTION 5. The interest and sinking fund requirements of the moneys expended in constructing that part of the sewerage system provided for in this act, and the cost of maintenance and operation thereof, shall be deemed and paid as a part of the interest, sinking fund requirements and costs specified in said chapter four hundred and six and acts in amendment thereof and in addition thereto; and the sinking fund established under the provisions of said chapter shall be a sinking fund for the extinguishment of the debt authorized by this act, said funds to be increased in the following manner: — The treasurer and receiver general shall from year to year, beginning with the year nineteen hundred and one, apportion to said sinking fund an amount sufficient with its accumulations to extinguish the debt at maturity; and in making the assessment for the increase of said sinking fund upon the several cities and towns liable thereto such proportions of the whole amount shall be assessed in each year as will harmonize with the proportions to be assessed on account of the sinking fund for loans now outstanding for the Neponset river valley metropolitan sewer system. Any premium realized from the sale of said scrip or certificates of debt shall be applied to the payment of the interest on said loan as it accrues.

When to take effect.

SECTION 6. This act shall take effect when the town of Brookline appropriates money to construct a sewer or sewers in said town to connect with the extension of the metropolitan sewer provided for by this act. [*Approved March 26, 1901.*

[CHAPTER 313.]

AN ACT TO AUTHORIZE THE TEMPORARY TAKING OF WATER FOR EMERGENCY PURPOSES BY CITIES AND TOWNS.

Be it enacted, etc., as follows:

Cities and certain towns may in cases of emergency take water from certain brooks, etc.

SECTION 1. Cities by their city councils, and towns having a system of water supply by their water commissioners or selectmen, may in cases of emergency and for a period not exceeding six months in any one year, take water from any brook, stream, river, lake, pond or reservoir, not already appropriated to uses of a municipal water supply, in such quantities as may be necessary to relieve the emergency; but water commissioners or selectmen of towns shall not make any such taking unless previously authorized so to do at some meeting of the inhabitants of the town regularly called therefor. They may also take such rights to use any land and for such time as may be necessary to use such water. Such vote of a city council or of a town meeting shall be conclusive as to the existence of the emergency. No such taking shall be made until the state board of health shall have first approved the water as a proper source of water supply.

Water to be approved by state board of health.

Description of taking to be recorded, etc.

SECTION 2. The city councils of cities and the water commissioners or selectmen of towns shall cause to be recorded in the registry of deeds for the county or district in which such water and land are situated, within thirty days after the taking, a description sufficiently accurate for identification, with a statement of the purpose and the time for which the same are taken, which statement shall be signed by the mayor of the city or by the chairman of the water commissioners or selectmen of the town making the taking, and upon such recording the right to use for the time stated in such taking shall vest in such city or town.

Damages.

SECTION 3. The city councils of cities and the water commissioners or selectmen of towns shall within sixty days after the termination of the exercise of any right taken under the provisions of this act estimate and determine, as near as may be, the actual damages sustained by any person by the taking of any water and of the right to use any land under this act; but any one aggrieved by such determination may have such damages assessed by a jury of the superior court, in the same manner as is provided by law with respect to damages sustained by the laying out of ways. If upon trial damages are increased beyond the amount determined as aforesaid, the aggrieved person shall recover costs, otherwise such person shall pay costs, and costs shall be taxed as in civil cases; but no suit or petition for such damages shall be brought after the expiration of two years from the date of the recording of the description and statement as aforesaid.

Certain duties, etc., to be exercised by the metropolitan water and sewerage board.

SECTION 4. The powers conferred upon and the duties to be performed by the city councils and mayors of cities under this act shall within those cities and towns using the metropolitan water supply be exercised by the metropolitan water and sewerage board. [*Approved April 23, 1901.*

[CHAPTER 429.]

AN ACT MAKING AN APPROPRIATION FOR MAINTAINING AND OPERATING THE QUINCY PUMPING STATION AND FORCE MAINS IN THE SOUTH METROPOLITAN SEWERAGE SYSTEM.

Be it enacted, etc., as follows:

Maintenance, etc., of Quincy pumping station, etc.

SECTION 1. A sum not exceeding fifty-five hundred dollars is hereby appropriated, to be paid out of the treasury of the Commonwealth from the ordinary revenue, for the maintenance and operation during the year ending on the thirty-first day of December, nineteen hundred and one, of the Quincy pumping station and force mains taken by the metropolitan water and sewerage board.

SECTION 2. This act shall take effect upon its passage. [*Approved May 23, 1901.*

[CHAPTER 442.]

AN ACT RELATIVE TO BONDS REQUIRED TO BE GIVEN UNDER CERTAIN CONTRACTS MADE BY THE METROPOLITAN WATER AND SEWERAGE BOARD.

Be it enacted, etc., as follows:

1897, 339, amended.

Certain rights, etc., of cities and towns not affected.

Chapter three hundred and thirty-nine of the acts of the year eighteen hundred and ninety-seven is hereby amended by inserting at the end thereof the following: — Nothing herein contained shall be construed to deprive any city or town of any rights or remedies under laws existing at the time of the passage of this act. [*Approved May 29, 1901.*

[CHAPTER 453.]

AN ACT TO PROVIDE FOR AN ADDITIONAL METROPOLITAN WATER LOAN.

Be it enacted, etc., as follows:

Metropolitan Water Loan.

SECTION 1. The treasurer and receiver general of the Commonwealth shall from time to time, on the request of the metropolitan water and sewerage board, issue negotiable bonds in the name and behalf of the Commonwealth and under its seal, designated on the face thereof, Metropolitan Water Loan, to an amount not exceeding thirteen million dollars, in addition to the twenty-seven million dollars authorized to be issued under the provisions of section seventeen of chapter four hundred and eighty-eight of the acts of the year eighteen hundred and ninety-five; and the provisions of said chapter and of acts in amendment thereof and in addition thereto shall apply to this additional loan, to the same extent as if the amount authorized by said act had been forty million dollars instead of twenty-seven million dollars.

SECTION 2. This act shall take effect upon its passage. [*Approved June 5, 1901.*

[CHAPTER 489.]

AN ACT TO CHANGE THE AMOUNT TO BE ASSESSED ANNUALLY UPON CITIES AND TOWNS UNDER THE ACT TO PROVIDE FOR A METROPOLITAN WATER SUPPLY.

Be it enacted, etc., as follows:

1895, 488, § 19, amended.

SECTION 1. Section nineteen of chapter four hundred and eighty-eight of the acts of the year eighteen hundred and ninety-five, being "An act to provide for a Metropolitan Water Supply", is hereby amended by striking out all after the word "treasurer", in the thirty-second line, to and including the word "apportioned", in the forty-fourth line, so as to read as follows: — *Section 19.* Said treasurer shall in each year estimate the amount, in addition to the premiums from sales of said bonds and the proceeds from the operations of said board, exclusive of the proceeds from sales of property, required during the year to pay the interest, sinking fund requirements, expenses of maintenance and operation of said water works, and shall apportion to the city of Boston the proportion of such amount that the valuation of said city for the preceding year bears to the total of all such valuations of all cities and towns in said water district: *provided, however*, there shall be included only one sixth of the total valuation of any such city and town which has not reached the safe capacity of its present sources of supply in a dry year, as determined by said water board and certified to said treasurer, and has not made application to said board for water, and the remainder to the other cities and towns in said district, one third in proportion to their respective valuations and the remaining two thirds in proportion to their respective populations, including however only one sixth of the total valuation and one sixth of the total population of any such city and town which has not reached the safe capacity of its sources or of the sources of supply of the water company by which a town is supplied, or has not made application for water as aforesaid; and *provided, further*, that any city or town assessed upon its full valuation and population, which furnishes a part of its water supply from its own works or receives a supply from a water company, shall be allowed and credited in its apportionment with a sum equal to twelve dollars for each million gallons of water furnished as aforesaid, as determined by said water board and certified to said treasurer. Said treasurer shall in each year notify each city and town of the amount of its assessment, and the same shall be paid by the city or town into the treasury of the Commonwealth at the time required for the payment and as part of its state tax.

Treasurer to estimate amount required for payment of expenses, etc.

Provisos.

Payment of assessments.

SECTION 2. This act shall take effect upon its passage. [*Approved June 13, 1901.*

[Chapter 498.]

An Act to extend the time for filing petitions for damages, and offers of surrender of real estate, under the act to provide for a metropolitan water supply.

Be it enacted, etc., as follows:

1899, 342, § 1, etc., amended.

Section 1. Section one of chapter three hundred and forty-two of the acts of the year eighteen hundred and ninety-nine, as amended by section one of chapter one hundred and eight of the acts of the year nineteen hundred, is hereby further amended by striking out the word "one", in the seventeenth line, and inserting in place thereof the word: — four, — so as to read as follows: — *Section 1.* Petitions under the provisions of section fourteen of chapter four hundred and eighty-eight of the acts of the year eighteen hundred and ninety-five, or of section one of chapter four hundred and forty-five of the acts of the year eighteen hundred and ninety-seven, and acts in amendment thereof or in addition thereto, for the determination of damages for the taking of real estate may be filed, as provided by law, within two years after the actual taking by right of eminent domain of such real estate or of any interest therein, and petitions for the determination of damages for the taking of water rights where no land is taken in connection with such water rights, and for the determination of all other damage provided for in said acts, and offers of surrender of real estate provided for in said acts, may be filed on or before the first day of July in the year nineteen hundred and four.

Time within which certain petitions for damages, etc., may be filed, extended.

Section 2. This act shall take effect upon its passage. [*Approved June 13, 1901.*

[Chapter 505.]

An Act relative to the payment to certain persons in the town of Clinton of damages sustained under the act to provide for a metropolitan water supply.

Be it enacted, etc., as follows:

1895, 488, § 14, etc., amended.

Section 1. Section fourteen of chapter four hundred and eighty-eight of the acts of the year eighteen hundred and ninety-five, as amended by chapter five hundred and fifty-one of the acts of the year eighteen hundred and ninety-eight, is hereby further amended by inserting after the word "Boylston", in the fifth and eleventh lines, respectively, of section one of said chapter five hundred and fifty-one, the words: — or in that part of the town of Clinton within the limits of the Wachusett reservoir, — so that said section fourteen of chapter four hundred and eighty-eight, after the word "court", in the fiftieth line, shall read as follows: — In case any individual or firm owning on the first day of April in the year eighteen hundred and ninety-five an established business on land in the town of West Boylston, or on land in the town of Boylston, or in that part of the town of Clinton within the limits of the Wachusett reservoir, whether the same shall be taken or not under this act, or the heirs or personal representatives of such individual or firm, shall deem that such business is decreased in value by the carrying out of this act, whether by loss of custom or otherwise, and unable to agree with said board as to the amount of damages to be paid for such injury, such damages shall be determined and paid in the manner hereinbefore provided. The words "real estate", as used in this section, shall include water rights, and in the case of mills all machinery thereon.

Determination of damages to certain business establishments.

Words "real estate" defined.

SECTION 2. This act shall take effect upon its passage. [*Approved June 14, 1901.*

[CHAPTER 509.]

AN ACT TO REQUIRE THE METROPOLITAN WATER AND SEWERAGE BOARD TO IMPROVE THE CONDITION OF THE COCHITUATE WATER BASIN.

Be it enacted, etc., as follows:

Condition of Cochituate water basin to be improved, etc.

SECTION 1. The metropolitan water and sewerage board, within two years from the passage of this act, shall cause that part of the Cochituate reservoir known as Pegan Meadow, located in the town of Natick, and that part of said reservoir in the towns of Wayland and Natick known as Snake Brook meadow, to be cleaned and excavated to a level of three feet above the bottom of the aqueduct from said reservoir, and the banks of the said meadows to be improved so that mud deposits shall not be exposed thereon at low stages of the water; and in the execution of this work the board may decrease the flowed area of the said meadows to such extent as it shall see fit. The cost of said work shall be paid out of the Metropolitan Water

Loan Fund: *provided, however,* that the amount so expended shall not exceed one hundred thousand dollars; and if the board shall find it impossible to excavate said meadows to the depth herein specified and to carry out all the provisions hereof for said sum, then said work shall be prosecuted to such extent as may reasonably be done for the sum of one hundred thousand dollars.

Proviso.

SECTION 2. The provisions of section twenty-eight of chapter four hundred and eighty-eight of the acts of the year eighteen hundred and ninety-five for the enforcement of the act to provide for a metropolitan water supply shall apply to this act.

Certain provisions of law to apply.

SECTION 3. This act shall take effect upon its passage. [*Approved June 14, 1901.*

[CHAPTER 513.]

AN ACT TO AUTHORIZE THE ADVANCEMENT OF MONEYS FOR THE PURPOSES OF THE METROPOLITAN WATER AND SEWERAGE BOARD.

Be it enacted, etc., as follows:

SECTION 1. There may be advanced from the treasury of the Commonwealth to such person as shall be designated by the metropolitan water and sewerage board such sums of money, not exceeding twenty thousand dollars at any one time, as the auditor of accounts may certify to the treasurer of the Commonwealth to be necessary to enable said board to make direct payments upon their pay rolls and other accounts. Said sum may be advanced from any loan or appropriation under the control of the metropolitan water and sewerage board. The person to whom this money is advanced shall within thirty days from the receipt of any sum file with the auditor of accounts a statement in detail of the moneys expended, approved by the metropolitan water and sewerage board, and, where it is practicable to obtain them, receipts or other like vouchers of the persons to whom the payments have been made. The person so designated shall give a bond with sufficient sureties, to be approved by the auditor of accounts, in the sum of twenty thousand dollars.

Certain sums of money may be advanced for the purposes of the metropolitan water and sewerage board, etc.

SECTION 2. All acts and parts of acts inconsistent herewith are hereby repealed.

Repeal.

SECTION 3. This act shall take effect upon its passage. [*Approved June 14, 1901.*

[CHAPTER 516.]

AN ACT TO PROVIDE FOR CERTAIN ANNUAL PAYMENTS TO THE TOWN OF HOPKINTON ON ACCOUNT OF THE CONSTRUCTION OF THE METROPOLITAN WATER SYSTEM.

Be it enacted, etc., as follows:

Treasurer of the Commonwealth to make certain annual payments to the town of Hopkinton.

SECTION 1. The treasurer of the Commonwealth shall pay to the town of Hopkinton as a part of the expenses of the metropolitan water works, the sum of twelve hundred dollars in the month of September in the year nineteen hundred and one, and a like sum in the same month in each succeeding year until ten years after the reservoirs or basins situated in said town cease to be a part of the metropolitan water system: *provided*, that the town shall continue to be a municipality during that time; but shall pay no tax and make no other payment to said town on account of any property held by said water board for the purposes of a water supply.

Proviso.

SECTION 2. This act shall take effect upon its passage. [*Approved June 18, 1901.*

RESOLVES.

[CHAPTER 101.]

RESOLVE TO PROVIDE FOR THE APPOINTMENT OF A COMMITTEE TO DETERMINE WHETHER COMPENSATION SHOULD BE PAID TO THE TOWNS OF CLINTON, STERLING AND HOLDEN BY REASON OF THE CONSTRUCTION OF THE WACHUSETT RESERVOIR BY THE METROPOLITAN WATER AND SEWERAGE BOARD.

Committee to determine as to compensation to Clinton, Sterling and Holden by reason of the construction of the Wachusett reservoir, appointment, etc.

Resolved, That the governor of the Commonwealth is hereby authorized to appoint a committee of three persons to determine whether any, and what amount of, compensation should be paid to the towns of Clinton, Sterling and Holden, as municipalites, and not to the individual citizens thereof, by reason of the construction of the Wachusett reservoir, or of any other acts done under authority of chapter four hundred and eighty-eight of the acts of the year eighteen hundred and ninety-five and the amendments thereof. The said committee shall receive such compensation for their services as the governor and council may fix, and shall report to the general court at its next session, not later than the fifteenth day of January in the year nineteen hundred and two. Any vacancy occurring in the committee may be filled by the governor. [*Approved June 10, 1901.*

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PUBLIC DOCUMENT . . . . No. 65.

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